



TEST ARRAY NO. 1 FOR MINE DETECTION EXPERIMENTS

R. MAES

JANUARY 1980

THIS DOCUMENT IS BEST QUALITY PRACTICABLE.
THE COPY FURNISHED TO DDC CONTAINED A
STEMIFICANT NUMBER OF PAGES WHICH DO NOT

Approved for public release:
Distribution Unlimited

Prepared for
U.S. Army Mobility Equipment
Research and Development Command
Ft. Belvoir, VA
Contract DAAK70-78-C-0198



RESEARCH INSTITUTE OF MICHIGAN

BOY BEIR & ANN ARBOR & MICHIGAN 48107

80 6 30 101

NOTICES

Sponsorship. The work reported herein was conducted by the Environmental Research Institute of Michigan for the U.S. Army Mobility Equipment Research and Development Command under Contract DAAK 70-78-C-0198. Contracts and grants to the Institute for the support of sponsored research are administered through the Office of Contracts Administration.

The views, opinions, and/or findings contained in this report are those of the authors and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

<u>Distribution</u>. Initial distribution is indicated at the end of this document.

<u>Final Disposition</u>. After this document has served its purpose, it may be destroyed. Please do not return it to the Environmental Research Institute of Michigan.

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

A TITLE (and Subility) TEST ARRAY No. 1 FOR MINE DETECTION EXPERIMENTS. Technical Report. Technical Proposition 1 18 00 00 00 00 00 00 00 00 00 00 00 00 00	REPORT NUMBER	MENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
TEST ARRAY No. 1 FOR MINE DETECTION EXPERIMENTS. Technical Report. T		2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
Technical Report. Technical Rep		AD-AU86 141-	
7 AUTHOR(s) 8. PERFORMING ORGANIZATION NAME AND ADDRESS Environmental Research Institute of Michigan P.O. Box 8618, Ann Arbor, MI 48107 11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Mobility Equipment Research and Development Command, Mine Detection Division, Ft. Belvoir, VA 22060 13. NUMBER OF PAGES Vi + 82 14. MONITORING AGENCY NAME AND ADDRESS (if different from Controlling Office) Approved for public release; distribution unlimited 15. DISTRIBUTION STATEMENT (of the abstract entered in Black 20. if different from Report) 18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse tide if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Art port. The topography, soil, and vegetation of the site is representative of the North Test of the result of the result of the site is representative of the North Test of the result of the result of the site is representative of the north Island Test of the site is representative of the ments, each 50 m by 100 m in size. Each of the elements was used for installation mines, either surface or burled, in specific configurations, for the location of variance of the site is resulting united.	4. TITLE (and Subtitle)		5 TYPE OF REPORT & PERIOD COVE
AUTHOR(s) R. Author(s) R. Author(s) R. Author(s) DAAK76-78-C-G198 D. PROGRAM ELEMENT. PROARE AND ADDRESS U.S. Army Mobility Equipment Research and Development Command, Mine Detection Division, Ft. Belvoir, VA 22060 13. NUMBER OF FAGES vi + 82 14. MONITORING AGENCY NAME AND ADDRESS (if different from Controlling Office) 15. SECURITY CLASS (of the r Unclassified 15. DESTRIBUTION STATEMENT (of the Abstract entered in Black 20. if different from Report) 16. DISTRIBUTION STATEMENT (of the Abstract entered in Black 20. if different from Report) 17. DISTRIBUTION STATEMENT (of the Abstract entered in Black 20. if different from Report) 18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse tide if necessary and identify by black number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation mines, either surface or burled, in specific configurations, for the location of var	TEST ARRAY N 1 FOR MIN	E DETECTION EXPERIMENTS.	Technical Report,
PERFORMING ORGANIZATION NAME AND ADDRESS Environmental Research Institute of Michigan P.O. Box 8618, Ann Arbor, MI 48107 II. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Mobility Equipment Research and Development Command, Mine Detection Division, Ft. Belvoir, VA 22060 II. MONITORING AGENCY NAME AND ADDRESS (if different from Controlling Office) II. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited II. DISTRIBUTION STATEMENT (of the abstract entered in Black 20, if different from Report) II. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project II. SECURITY CLASS (of the r Unclassified III. DISTRIBUTION STATEMENT (of the abstract entered in Black 20, if different from Report) III. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project III. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project III. SUPPLEMENTARY NOTES Dr. ANSTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of variances.		(N) Sh	138300-38-T
9. PERFORMING ORGANIZATION NAME AND ADDRESS Environmental Research Institute of Michigan P.O. Box 8618, Ann Arbor, MI 48107 11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Mobility Equipment Research and Development Command, Mine Detection Division, Ft. Belvoir, VA 22060 13. NUMBER OF PAGES vi + 82 14. MONITORING AGENCY NAME AND ADDRESS (if different from Controlling Office) Approved for public release; distribution unlimited 15. DISTRIBUTION STATEMENT (of the abstract entered in Black 20. if different from Report) 16. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Vertain Vagetation 20. Apstract (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation on mines, either surface or buried, in specific configurations, for the loctan of varmines, either surface or buried, in specific configurations, for the loctan of varmines, either surface or buried, in specific configurations, for the loctan of varmines, either surface or buried, in specific configurations, for the loctan of varmines, either surface or buried, in specific configurations, for the loctan of varmines, either surface or buried, in specific configurations, for the loctan of varmines, either surface or buried, in specific configurations, for the loctan of varmines, either surface or buried, in specific configurations, for the loctan of varmines, either surface or buried, in specific configurations, for the loctan of varmines, either surface or buried, in specific configurations, for t	7. AUTHOR(s)	<u> </u>	8. CONTRACT OR GRANT NUMBER (
Environmental Research Institute of Michigan P.O. Box 8618, Ann Arbor, MI 48107 II. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Mobility Equipment Research and Development Command, Mine Detection Division, Ft. Belvoir, VA 22060 II. MONITORING AGENCY NAME AND ADDRESS (if different from Controlling Office) III. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited III. DISTRIBUTION STATEMENT (of the abstract entered in Block 20. if different from Report) III. DISTRIBUTION STATEMENT (of the abstract entered in Block 20. if different from Report) III. DISTRIBUTION STATEMENT (of the abstract entered in Block 20. if different from Report) III. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project III. NEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Terrain Vagetation II. OPPOVIDE for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb Port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation or mines, either surface or buried, in specific configurations, for the location of variants was used for installation or mines, either surface or buried, in specific configurations, for the location of variants.	R. Maes		DAAK7Ø-78-C-Ø198
Environmental Research Institute of Michigan P.O. Box 8618, Ann Arbor, MI 48107 11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Mobility Equipment Research and Development Command, Mine Detection Division, Ft. Belvoir, VA 22060 13. NUMBER OF FAGES vi + 82 14. MONITORING AGENCY NAME AND ADDRESS (if different from Controlling Office) 15. SECURITY CLASS (of the r Unclassified 15. DISTRIBUTION STATEMENT (of the Abstract entered in Black 20, if different from Report) 17. DISTRIBUTION STATEMENT (of the abstract entered in Black 20, if different from Report) 18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Terrain Vagetation 20. AgeTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation or mines, either surface or buried, in specific configurations, for the location of var mines, either surface or buried, in specific configurations, for the location of var	9. PERFORMING ORGANIZATION N	NAME AND ADDRESS	
U.S. Army Mobility Equipment Research and Development Command, Mine Detection Division, Ft. Belvoir, VA 22060 13. NUMBER OF PAGES vi # 82 14. MONITORING AGENCY NAME AND ADDRESS (if different from Controlling Office) 15. SECURITY CLASS (of this r Unclassified 15. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Ternain Vagetation 20. DETERNACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw Country, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled.		<u> </u>	AREA & WORK UNIT NUMBERS
U.S. Army Mobility Equipment Research and Development Command, Mine Detection Division, Ft. Belvoir, VA 22060 13. NUMBER OF PAGES vi + 82 14. MONITORING AGENCY NAME AND ADDRESS (if different from Controlling Office) 15. DISTRIBUTION STATEMENT(of this Report) Approved for public release; distribution unlimited 16. DISTRIBUTION STATEMENT(of the abstract entered in Block 20, if different from Report) 17. DISTRIBUTION STATEMENT(of the abstract entered in Block 20, if different from Report) 18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse tide if necessary and identify by block number) Mines Field Tests Weather Terrain Vagetation 20. DETRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw Country, MI approximately one mile west of Ann Art port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled, in specific configurations, for the location of variance or burled.	11. CONTROLLING OFFICE NAME	AND ADDRESS	12. REPORT DATE
Command, Mine Detection Division, Ft. Belvoir, VA 22060 13. NUMBER OF PAGES vi + 82 14. MONITORING AGENCY NAME AND ADDRESS (if different from Controlling Office) 15. SECURITY CLASS (of this result of the property) Approved for public release; distribution unlimited 16. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Terrain Vagetation 20. ASTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var		· · · · · · · · · · · · · · · · · · ·	-
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Vertain Vagetation 20. Approved for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Art port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of wines, either surface or buried, in specific configurations, for the location of variance or surface or buried, in specific configurations, for the location of variances.	, , , , ,	•	
Unclassified 15a DECLASSIFICATION/DOUNT SCHEDULE 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Terrain Vagetation 20. Approved for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Art port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation or mines, either surface or buried, in specific configurations, for the location of var			1
IS DECLASSIFICATION/DOUS SCHEDULE 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Terrain Vagetation 20. ADSTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var			15. SECURITY CLASS. (of this report)
Approved for public release; distribution unlimited 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Terrain Vagetation 20. ASTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Art port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var			į.
Approved for public release; distribution unlimited 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Terrain Vagetation 20. Approximate on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Art port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of variances.		•	154 DECLASSIFICATION/DOWNGRA
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Terrain Vagetation 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Art port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var	, ,	• ,	
Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Terrain Vagetation 20. ASTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var			
Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Terrain Vagetation 20. ASSTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var			
Dr. J.R. Gonano was the contract monitor for this project 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mines Field Tests Weather Terrain Vagetation 20. ASSTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var	17. DISTRIBUTION STATEMENT (o)	f the abstract entered in Block 20, if different from Ro	eport)
Mines Field Tests Weather Terrain Vagetation 20. ASSTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var		f the abstract entered in Block 20, if different from Ro	eport)
Mines Field Tests Weather Terrain Vegetation 20. AssTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var	18 SUPPLEMENTARY NOTES		eport)
Mines Field Tests Weather Terrain Vegetation 20. AssTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var	18. SUPPLEMENTARY NOTES		eport)
Field Tests Weather Terrain Vagetation 20. Asstract (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var	18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the	contract monitor for this project	eport)
Weather Terrain Vagetation 20. ASSTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var	18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the	contract monitor for this project	eport)
Vegetation 20. ASSTRACT (Continue on reverse side if necessary and identify by block number) To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var	18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the 19. KEY WORDS (Continue on reverse Mines	contract monitor for this project	epori)
To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var	18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the 19. KEY WORDS (Continue on reverse Mines Field Tests	contract monitor for this project	epori)
To provide for the conduct of remote mine detection tests, a test array was est on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var	18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the 19. KEY WORDS (Continue on reverse Mines Field Tests Weather	contract monitor for this project	sport)
on a twenty-acre site in Washtenaw County, MI approximately one mile west of Ann Arb port. The topography, soil, and vegetation of the site is representative of the Nor Plain. The total area, roughly 200 m by 400 m, was divided into 16 rectangular area ments, each 50 m by 100 m in size. Each of the elements was used for installation of mines, either surface or buried, in specific configurations, for the location of var	18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the 19. KEY WORDS (Continue on reverse Mines Field Tests Weather Terrain Vagetation	contract monitor for this project e side if necessary and identify by block number)	sport)
mines, either surface or buried, in specific configurations, for the location of var	18. SUPPLEMENTARY NOTES Dr. J.R. Gonano was the 19. KEY WORDS (Continue on reverse Mines Field Tests Weather Terrain Vagetation	contract monitor for this project e side if necessary and identify by block number)	eport)
	Dr. J.R. Gonano was the 19. KEY WORDS (Continue on reverse Mines Field Tests Weather Terrain Vegetation 20. ASSTRACT (Continue on reverse To provide for the on a twenty-acre site in port. The topography, s Plain. The total area,	contract monitor for this project e side if necessary and identify by block number) side if necessary and identify by block number) conduct of remote mine detection to Washtenaw County, MI approximately and vegetation of the site is roughly 200 m by 400 m, was divide	tests, a test array was establis ly one mile west of Ann Arbor Ai s representative of the North Ge ed into 16 rectangular areas or

DD FORM 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

401903.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

20. ABSTRACT (Continued)

instrumentation or calibration units. Configurations of each element are documented, and data are presented on test site vegetation, soil conditions, and soil moisture content, also on meteorological conditions during periods when overflights were made for mine detection tests of various sensors.

	lon For	
NTIS (Grani	
DDC EA	В	1
Un accesso		[]
Justif	ieution_	
Dev		
-		
	bution/	
Avail	ability	Codes
	Availar	
Dist.	speci	al
νι υ ί. Λ	1 6/1	
110	ነ ነን አለ	
ν	1201	

UNCLASSIFIED

PREFACE

The objective of the minefield detection project is to determine the effectiveness of remote sensing systems and other methods of detecting and identifying mines, minefields, minelaying equipment, or minelaying operations, and to recommend continuing effort on the most promising methods.

Work under the project concerned with each of the concepts to be investigated is being performed in a sequence of four major tasks:

(1) identification and screening of promising techniques; (2) preliminary systems analysis and definition of experimental or other data acquisition systems; (3) acquisition of critical data through experiment, literature survey, or access to SCI; and (4) evaluation of conceptual systems for technical performance and military usefulness.

This is one of a series of reports documenting technical effort and results achieved during the project. This report covers work performed under Task 3, Critical Data Acquisition, for planning and implementation of a test array located on a site near Ann Arbor, MI. The test array is required for testing and evaluating various types of minefield detection devices and systems.

Dr. J. Roland Gonano monitored the program for MERADCOM, Mr. Henry McKenney was the ERIM Program Manager, and Mr. Reed Maes supervised the installation of the mine array. E. Johansen, G. Suits, and D. Bornemeier of ERIM also participated in planning and setting up the mine array.

ERIM wishes to thank Dr. John Bennett and Mr. Gordon McInnes of TARADCOM who made arrangements for the military vehicles and radar decoys used in the mine arrays. Also, Mr. Robert Falls of MERADCOM provided advice on test site requirements and measured data on test site soil characteristics.



TABLE OF CONTENTS

PRE	ACE	ii	i
1.	INTRO	DDUCTION	. 1
2.	2.1	SITE DESCRIPTION Test Site Requirements Test Site Selection	3
3.	TEST	MINE PROCUREMENT	8
4.	4.1		3
5.	TEST	ARRAY2	?1
	5.2	5.1.1 Surface Mines 5.1.2 Hand-Buried Mines 5.1.3 Minelayer Buried Mines 5.1.4 Scatterable Mines Military Vehicles and Inferential Characteristics Ground Truth 5.3.1 Weather Information 5.3.2 Terrain Conditions 5.3.3 Calibration Data	21 22 22 22 32 33 33 34
6.	TEST	CONDITIONS FOR FLIGHT TESTS	}5
APPI	ENDIX	A. ASSESSMENT OF MINE CHARACTERISTICS	54
APPI	ENDIX	B. METEOROLOGICAL DATA6	5 4
REF	ERENCI	ES8	37
חזכ:	TR TRII	TION LIST	12



LIST OF FIGURES

Figure	2-1.	First Test Array Site6
Figure	2-2.	Aerial Photograph of Test Array and Environs7
Figure	3-1.	Mines Used in Test Array9
Figure	4-1.	General Layout of Test Site and Surroundings14
Figure	4-2.	Arrangement of Test Site Array Elements15
Figure	4-3.	Test Array Vegetation Height17
Figure	4-4.	Test Site Vegetation19
Figure	5-1.	Layout of the Test Array23
Figure	5-2.	Dimensional Location of Surface Mines25
Figure	5-3.	Dimensional Location of M-15s in Element 526
Figure	5-4.	Dimensional Location of PM-60s in Element 627
Figure	5-5.	Dimensional Location of Minelayer Buried Mines in Element 7
Figure	5-6.	Dimensions of the Minecord M-15s used in Element 929
Figure	5-7.	Dimensional Location of Dummy Holes in Element 1030
Figure	5-8.	Dimensional Location of Scatterable Mines and Impact Holes of the Delivery Projectiles31
Figure	6-1.	Minefield Layout, July 19, 1979, 6:00 a.m36
Figure	6-2.	Minefield Layout, July 19, 1979, 10:00 a.m37
Figure	6-3.	Minefield Layout, July 19, 1979, 4:10 p.m38
Figure	6-4.	Minefield Layout, July 19, 1979, 9:10 p.m39
Figure	6-5.	Minefield Layout, July 20, 1979, 10:00 a.m40
Figure	6-6.	Minefield Layout, July 20, 1979, 12:30 p.m41
Figure	6-7.	Minefield Layout, July 25, 1979, 12:00 noon42
Figure	6-8.	Minefield Layout, July 27, 1979, 11:00 a.m. and 1:30 p.m
Figure	6-9.	Minefield Layout, August 1, 1979, 9:25 a.m44
Figure	6-10.	Minefield Layout, August 2, 1979, 9:45 a.m45
Figure	6-11.	Minefield Layout, August 3, 1979, 12:00 noon46
Figure	6-12.	Minefield Layout, September, 197947



LIST OF FIGURES (CONTINUED)

Figure B-1.	Record of River and Climatological Observations	65
Figure B-2.	Hygro-Thermograph Chart	75

LIST OF TABLES

Table 6-1.	Ground Truth Temperatures, 19 July 1979, 11:00 a.m48
Table 6-2.	Ground Truth Temperatures, 19 July 1979, 4:00 p.m. and 9:15 p.m
Table 6-3.	Ground Truth Temperatures, 20 July 1979, 10:00 a.m. and 12:30 p.m
Table 6-4.	Ground Truth Temperatures, 1 August 1979, 11:00 a.m51
Table 6-5.	Schedule of Minefield Test Components52
Table B-1.	Supplemental Remarks

TEST ARRAY NO. 1 FOR MINE DETECTION EXPERIMENTS

1 INTRODUCTION

In order to evaluate the technical effectiveness and operational utility of various methods of minefield detection, a program of analysis and experiment is being performed under the minefield detection project. Minefield detection techniques and systems which appear to have good potential for effectively performing this function are being selected under this project by a process of identification and screening. Selection of sensors and sensor features will be made considering types of surveillance systems presently in inventory or designs of systems in the R & D stage which can be reasonably anticipated to perform under battlefield conditions.

An important part of the overall program is the acquisition of data needed to answer critical questions concerning the usefulness of selected techniques. Task 3 is intended to cover data acquisition involving sizable efforts which will be implemented after sponsor review and approval.

In many cases, the acquisition of critical data requires the conduct of flight tests or field experiments to ascertain the capability of selected sensors to detect and/or identify individual mines, minefields, minelaying equipment, minelaying activities or ancillary equipment, such as field fortifications, likely to be associated with the presence of mines. The criteria for success in evaluating the mine detection and identification capability will be essentially the probability of detection or identification under anticipated battlefield conditions. False alarm rates are also of importance.

ERIM

In order to conduct realistic tests of this capability, the presence of mines or associated equipment must be simulated under circumstances representative of anticipated operational conditions. For this purpose, one or more test arrays are needed to simulate the essential elements of various scenarios, including various types of terrain likely to be encountered. They must be designed to accommodate both direct and inferential modes of minefield detection. Ground-based sensors as well as airborne sensors must be accommodated by the test facilities.

The scenarios selected for analysis and testing of minefield detection techniques are based on combat operations in the European theater, and in particular in three areas of West Germany: the North German Plain, the Fulda Gap, and the Hof Corridor. The climate and terrain for these areas have been studied under another task of this project, and reports documenting these characteristics have been prepared (Refs. 1 and 2).

The test site described in this report has characteristics of soil, vegetation, topography, etc., representative of the North German Plain. The weather, soil, and vegetation data of the test site area were monitored during the program and are included as part of the data base.

2 TEST SITE DESCRIPTION

2.1 TEST SITE REQUIREMENTS

In order to provide a basis for selection of a suitable test site or sites for the installation of the test array of mines and related equipment, a set of requirements was developed. The following list describes the major requirements for test sites representing the characteristics of the three areas of West Germany mentioned above.

- (1) The sites should have soil characteristics, moisture content and vegetation representative of Eastern Europe.
- (2) There should be a variety of background including flat land and rolling terrain with vegetation and crops.
- (3) The sites should be representative of tactical situations with surface and buried mines of various types. There should be an opportunity for both direct and inferential detection.
- (4) The sites should be in a location suitable for both airborne and ground-based data collection.
- (5) The sites should have sufficient security to protect any military equipment needed for the experiment.
- (6) At the same time, the sites should be accessible to the project personnel.

For Test Array No. 1, certain additional requirements were specified.

- (7) The test site should be located near Ann Arbor, MI to enable the ERIM staff to perform ground operations and conduct flight tests from its aircraft efficiently. In addition to flight especially scheduled for the project, it might also be possible to acquire additional sensor data as the ERIM aircraft passes over the test site on its way to other test sites. This would provide much added data at little incremental data acquisition cost.
- (8) A non-military rural atmosphere was desired in order to allow for a realistic setting for the measurement program, a setting where farming and cultivation practices could continue in a reasonably uninterrupted manner while a military scenario could develop without causing concern to the local population.

Test Array No. 1, which is fully described in this report, meets these requirements for a site representative of the North German Plain. Additional test arrays, if implemented, would be selected to be representative of the other two areas mentioned.

2.2 TEST SITE SELECTION

The initial investigation was directed toward setting up two test sites -- one that satisfied the desired flat terrain characteristics and another in close proximity that satisfied the rolling terrain requirements. The effort was soon narrowed to selecting a single site with flat terrain.

The selection process involved examining good topographic and soil identification maps in the two-county area of interest near Ann Arbor. The process also required having a working knowledge of the rural, industrial, and governmental developments in the region that might make suitable sites. Through this process, eight locations were selected for possible use, two adjacent to Willow Run Airport, a fence-enclosed automotive testing facility, and five rural sites. Many of the sites had to be eliminated because of availability, security, or soil conditions.

ERIM

One of the sites considered in detail is located about 7 mis. southeast of the center of Ann Arbor, and about 10 mis. west of Willow Run Airport, where the ERIM Flight Facilty is located. The site is approximately rectangular with dimensions of roughly 200 m by 400 m. The shape of the planned test array could be modified slightly to fit these dimensions. The area is flat grassland, presently used for hay crops. However, this site was rejected because it was found to have soil characteristics not fully representative of West German terrain of interest.

The site finally selected for the first test array has characteristics representative of the North German Plain. The twenty acre site is situated on the 185 acre Warner farm in Pittsfield Township of Washtenaw County approximately one mile west of Ann Arbor Airport. The area is shown in Figures 2-1 and 2-2. The twenty acres is at the southwest corner of the farm and is approximately one-half mile from any public road. It is accessed by a private lane. After acquisition of the site, a gate was installed to limit unwanted traffic in this lane. The area is typical Michigan countryside and the field is bounded by a wood lot on the west side and a portion of the south side, and bounded by the lane and a drainage ditch on the east side. The area was planted in alfalfa a few years prior to its use as a test site so the vegetation is a mixture of alfalfa with other grasses. The soil types include Matherton sandy loam and Sebawa loam.

Soil maps of this site were obtained and soil samples were forwarded to MERADCOM for analysis. MERADCOM reviewed the site characteristics and reported that the soil types were suitable. Once approval of the site characteristics was received, ERIM proceeded with arrangements for leasing the site.

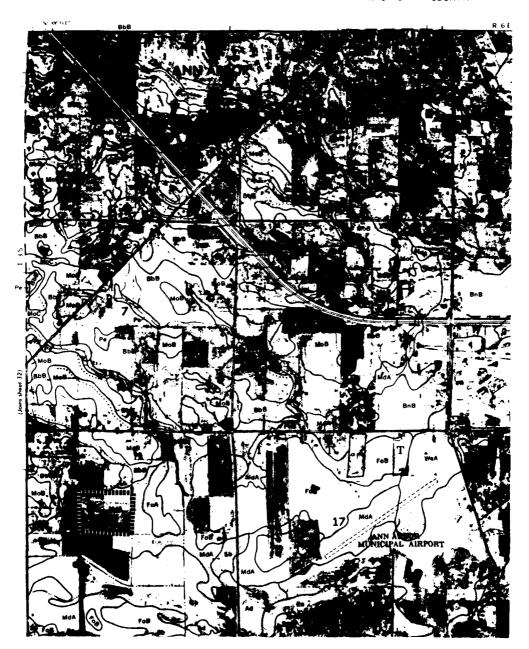


FIGURE 2-1. LOCATION OF TEST ARRAY

FIGURE 2-2. AERIAL PHOTOGRAPH OF TEST ARRAY AND ENVIRONS

3 TEST MINE PROCUREMENT

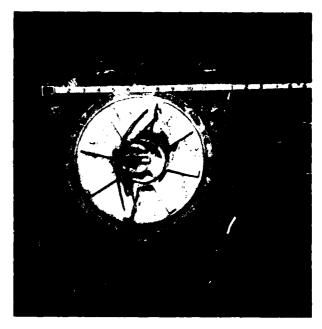
Four types of mines were used in the test array as shown in Figure 3-1. They were the M-15, M-19, PM-60, and artillery scatterable mines. Plastic PM-60 and metallic TM-46 Russian mines were replaced in our tests with simulated PM-60's procured under this contract and metallic U.S. Army M-15's which are roughly equivalent to the TM-46. Supplementary data to show the equivalency of the simulated PM-60 to the real PM-60 and also the M-15 U.S. antitank mine to the TM-46 Russian equivalent are presented in Appendix A.

It was originally proposed that dummy mines to be used in the test array would be supplied as GFE. However, to supplement mines available on a GFE basis, it was later decided that ERIM would undertake procurement of the mines as a separate task in the project. Plans for obtaining 450 dummy PM-60 mines were developed. The physical characteristics of the mines (size, shape, metallic content, dielectric characteristics of non-metallic materials, thermal characteristics, surface spectral characteristics) were specified by ERIM in sufficient detail so that solicitation of bids for the mines could proceed. For this purpose, spectral measurements were made on the coating of the mines. A sample of a metallic fuze was obtained from MERADCOM so that its characteristics could be accurately simulated.

One problem addressed in performing the test program was the selection and use of suitable paint for the test mines. ERIM worked with Dr. Fred L. Lafferman (DRDME-VO) at MERADCOM to specify paint which closely simulates the Soviet PM-60 paint. Dr. Lafferman analyzed a paint chip from the PM-60 sent to him by ERIM and informed ERIM that TTE-529 olive was satisfactory for measurements at 1.06 and 10.6 micrometers. ERIM obtained standard Army paint (529c) from the U.S. Army Tank-Automotive Research and Development Command



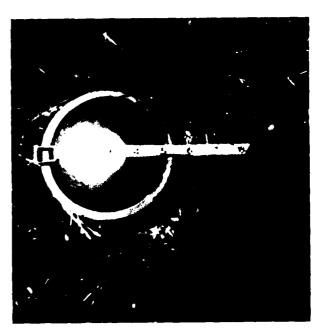
(A) M-15 Metallic



(B) M-19 Plastic



(C) PM 60 Plastic



(D) Scatterable Mines-Metallic

FIGURE 3-1 MINES USED IN TEST ARRAY (TARADCOM) and used it to paint the four dummy PM-60 mines used in early tests.

Based on recommendations received from Dr. Lafferman, ERIM ordered and received paints that simulate those used for Russian mines. These paints were obtained from Ameron Industry Coatings of Wichita, KA. TTE 529 olive paint was used with the plastic mines, and TTL 20 lacquer paint was used with the metal mines.

Quotations were obtained from potential suppliers of dummy mines and after a period of negotiation, one of them was selected. Discussions between ERIM and MERADCOM were then held concerning a supplement to the existing contract which would enable ERIM to obtain 450 simulated PM-60 mines for the experimental program. Pending approval of this add-on, ERIM in April 1979 authorized the vendor to proceed with fabrication of tooling for the mines at a cost of \$2,100.

A sample mine made from production tooling was supplied to MERADCOM for comment and approval. The requirement for fuzes and fuze wells in the first 190 mines was deleted. It was decided that only 20 mines would be supplied with fuzes and fuze wells.

Based on this review and approval, ERIM authorized the vendor to fabricate 190 mines for delivery on or before 6 July. This delivery date was selected to allow adequate time for installation of the mines in the array prior to conducting tests on the spotlight radar.

Of the 190 mines fabricated, 150 mines were used in the array. The remaining 40 were sent to Yuma for MERADCOM tests of a mine detector scheduled for mid-July, in accordance with MERADCOM's request.

Arrangements were also made through the Selected Ammunition Project Office of Picatinny Arsenal to obtain 50 inert scatterable anti-vehicular mines. When these mines were received, they were painted for use in the test array.



ERIM

About 500 mines were obtained from Ft. Huachuca for use in testing. These were predominantly metal M-15 mines, but some plastic M-19 mines were included. On receipt, 100 of the metal M-15 mines were painted field green and marked as inert mines for use in the array.

After tests were conducted at Test Array No. 1 using the above mines, it was decided that the additional simulated PM-60 mines to reach a total of 450 were not needed, and plans for their fabrication were not implemented.

4

TEST ARRAY

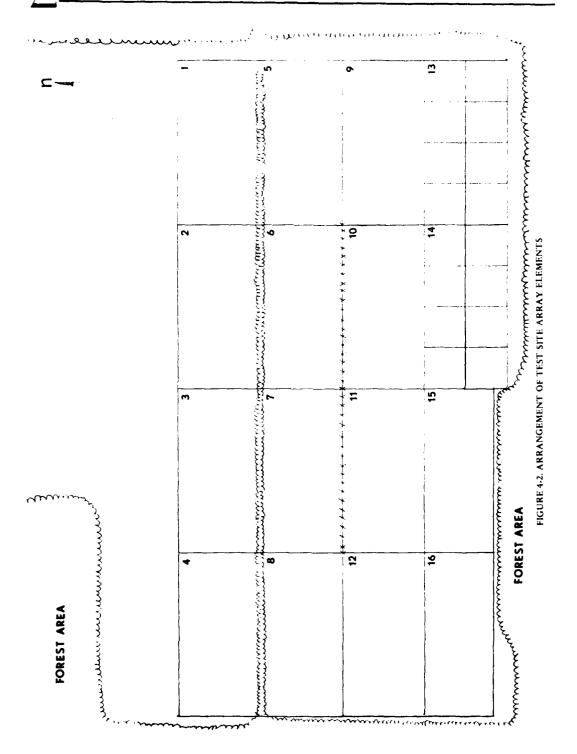
The general layout of the test site and its surroundings is shown in Figures 4-1 and 4-2. It is basically a standard twenty acre field that is 1/4 x 1/8 mile in size, roughly 200 m by 400 m. The total area is divided into 16 rectangular areas or elements, each 50 by 100 m in size. As discussed in Section 5, each of the elements is used for installation of dummy mines, either surface or buried, in specific configurations, for the location of various ancillary military items, as an undisturbed control area, or for the location of special instrumentation or calibration units. Section 4 describes the test site vegetation, soil conditions, and soil moisture content.

4.1 TEST SITE VEGETATION

The test site vegetation was, generally speaking, alfalfa plus mixed grasses. The general area to the south and west were bordered by a mature hardwood forest and to the east by an access lane and hedge row consisting of trees and shrubs up to 50 years old. The alfalfa field continued beyond the north side of the test site. There was a fence and hedge row in the E-W direction between elements 1-4 and 5-8 that contained trees and bushes that were at least twenty years old. In addition to this, there were four large mature oak trees located in the alfalfa field.

The alfalfa in elements 1-4 was a recent planting (3 years old) and had fewer weeds and miscellaneous grasses in it than the alfalfa in elements 5-16 (6 years old), although it was evident by some of the uneven growth in elements 5-16 that some reseeding had taken place in the last few years. The field experiments were set up so that no digging or major disturbance were made in elements 1-4; this area was used for surface mines only and was mowed during the week





SERIM

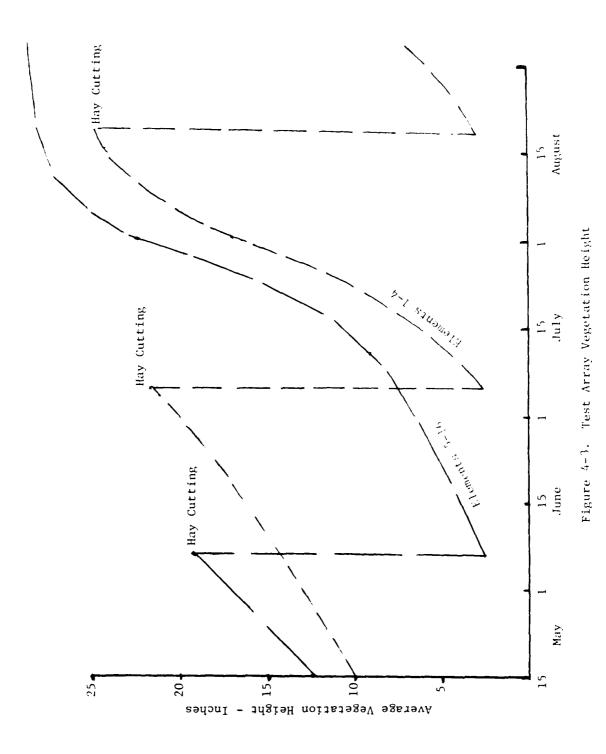
of July 4th. The alfalfa in elements 5-16 was mowed the second week in June since it was in this area where most of the test site preparations were required such as calibration arrays, buried mines, etc. For this reason the vegetation was taller by about 4 to 7 in during the data taking phases of July and August in the 5-16 elements. Figure 4-3 shows the average vegetation heights plotted during the experimental program. Figures 4-4 A, B, & C show the general vegetation in elements 1-4 and 5-16 respectively.

The vegetation density in elements 1-4 was fairly uniform, whereas the density in elements 5-16 tended to be streaked in the E-W direction because of variations in the reseeding. These streaks can be seen in some of the imagery and could easily be confused as vehicle path marks. The actual height of the vegetation was fairly dependent on weather conditions once the alfalfa was over 18 in high. On rainy days or when there was excessive moisture on the foliage, there was considerable matting so that the measured height would be less than 1 ft.

4.2 SOIL CONDITIONS AND SOIL MOISTURE CONTENT

The terrain of the test site contains two main soil types, Matherton sandy loam and Sebawa loam. It has a few small stones but no noticeable rocks of significant size. There is a large drainage ditch on the eastern edge of the site and the wooded area to the west is slightly lower in elevation than the open field. There is a very gentle slope downward to the western one-third of the site so that any water accumulation on the field tends to be at the west end.

A number of soil samples were delivered to MERADCOM for evaluation of soil constituents and moisture content. The soil texture ranging from very fine sandy loam to heavier loam was representative of the central region of West Germany.



FRIM

Moisture content measured in late March was found to be 24% and again in mid-July was found to be 18%. These numbers are higher than normal for Michigan because of the abnormal amount of rain that occurred during the spring and summer, but would be considered fairly typical for West Germany.



(A) Elements 1&2 Mid July



(B) Elements 1&2 Early August



(C) Elements 5&6 Mid July

FIGURE 4-4 TEST SITE VEGETATION

5 TEST ARRAY

Figure 5-1 is a layout of the test array. The approximate 200 by 400 m area is divided into 16 rectangular areas or elements, each 50 by 95 m in size. The 16 test elements were utilized as follows:

- (1) Il elements of mine configurations
- (2) 2 elements of military vehicles and components
- (3) 2 elements of calibration and instrumentation array
- (4) I empty reference element

The test site was surveyed and marked with sufficient stakes and lines to achieve 2 ft location accuracies within the elements. The element corners were implanted with 5 ft steel fence posts, superimposed with 2 ft \times 2 ft horizontal white fiber boards and radar corner reflectors.

5.1 TEST MINES

Test elements 1, 2, 3, 5, 6, 7, 8, 9, 10, 12, and 16 were used for various test mine configurations. The objective was to have as many variations as practical that represent real field conditions.

5.1.1 SURFACE MINES

Elements 1, 2, and 3 were used to distribute surface mines of the three mine types that were available in adequate quantities (M-15, M-19, and PM-60's), whereas element 4 is empty and undisturbed. The fields were as undisturbed as practical to simulate field conditions. Figure 5-2 shows the dimensions within these elements that mark the locations of the surface mines. Whenever conditions permitted, a vehicle loaded with fresh mines was



stationed in element 2 during flight tests for the purpose of substituting approximately ten mines for those that had been stabilized thermally.

5.1.2 HAND-BURIED MINES

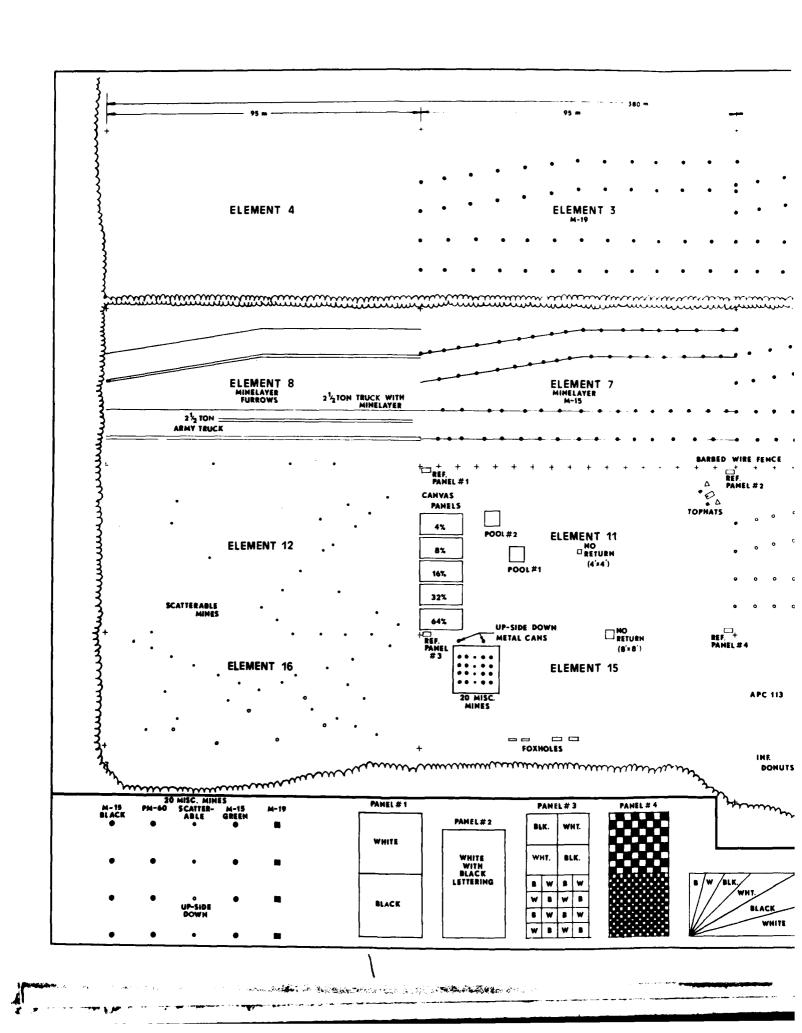
Test elements 5, 6, 9, and 10 were variations of hand buried mines. Figures 5-3, 5-4, & 5-7 show the dimensional locations of the M-15's, PM-60's in elements 5, 6, and 10; Figure 5-6 shows the dimensions of the minecord M-15's used in element 9.

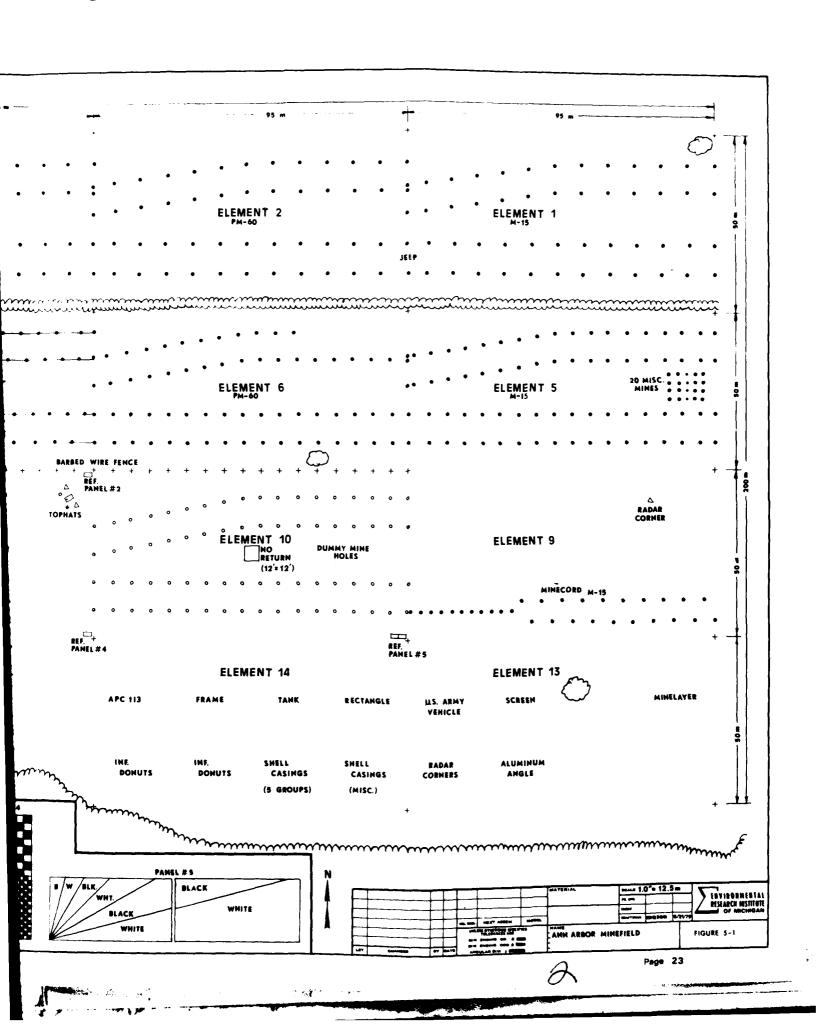
5.1.3 MINELAYER BURIED MINES

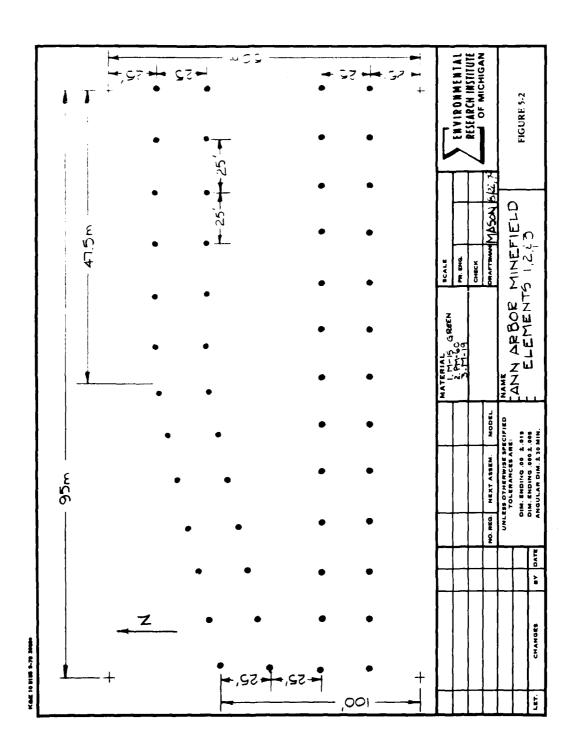
Elements 7 and 8 were devoted to variations in machine laid mines. Element 7 was planted with M-15's using the GFE minelayer plow pulled by a 2-1/2 ton truck. The element had four lines of mines as shown in Figure 5-5. Two of these lines were smoothed somewhat with shovels to help conceal the furrows and the other two lines were left as plowed by the minelayer. The minelayer did not distribute the mines at uniform distances in the element. The dimensions in the figure show where the actual locations of the mine were. Element 8 was plowed with four furrows but no mines were buried in this element. In element 8 two of the furrows were left uncovered and the other two had the furrows recovered. The layout for element 8 is the same as for element 7.

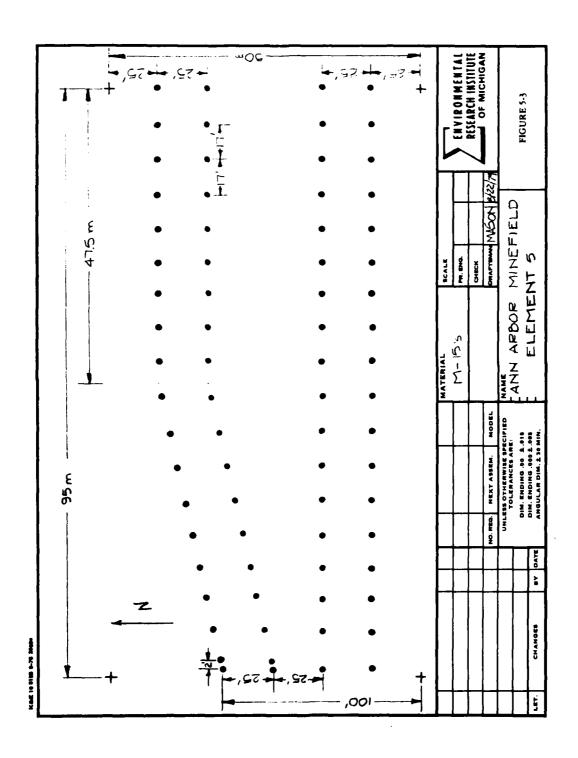
5.1.4 SCATTERABLE MINES

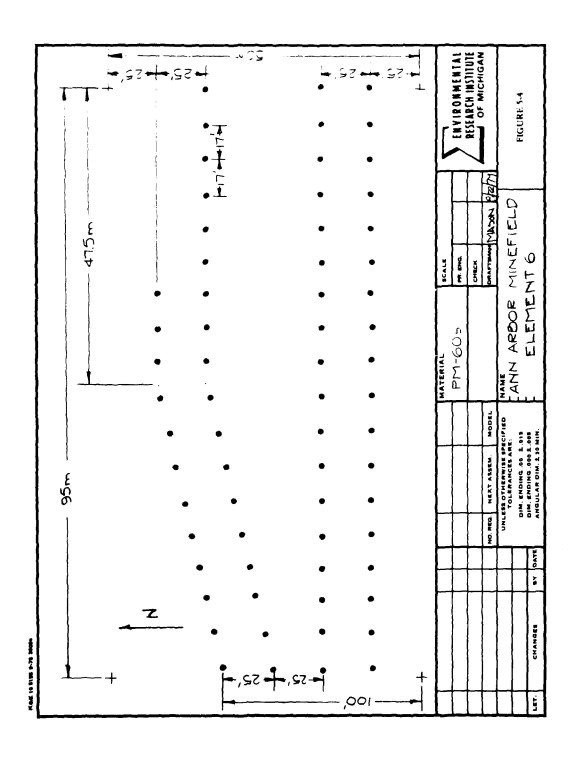
Elements 12 and 16 were used for setting up the scatterable mines. Figure 5-8 shows the locations of the scatterable mines and the impact holes of the delivery projectiles. Scarf marks left by the mines as they impact and roll to a resting place were simulated near each mine. Since the mines are not symmetrical, notations were made designating the orientation when they finished rolling. The test elements were set up as if 5 shell projectiles were delivered in the test zone.

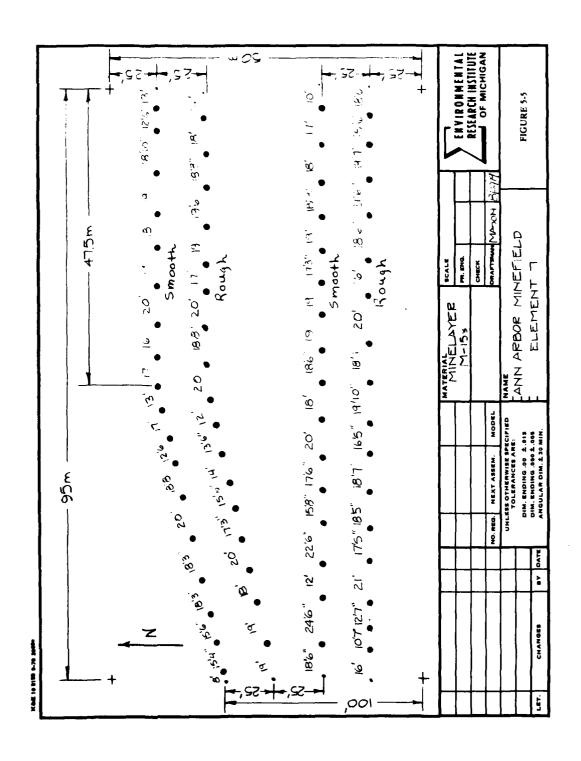


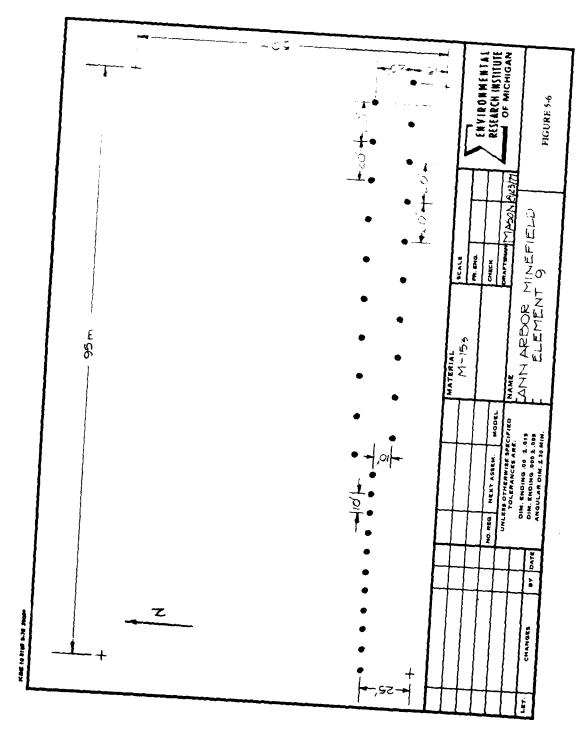


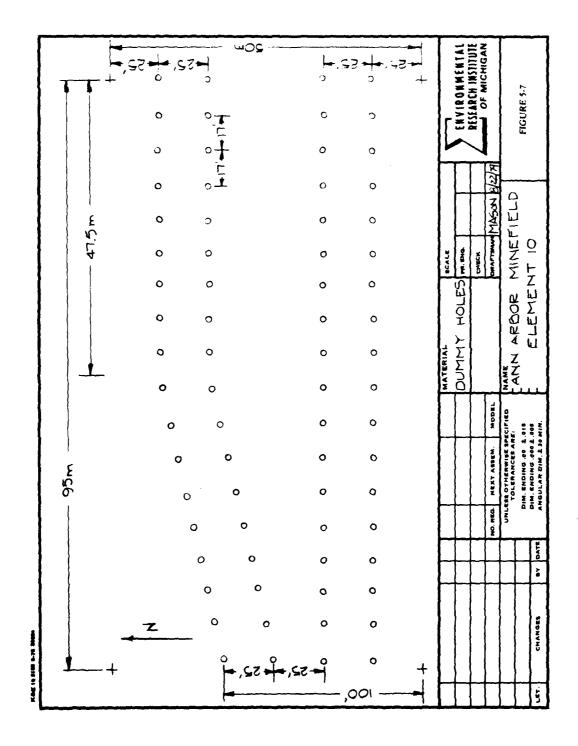


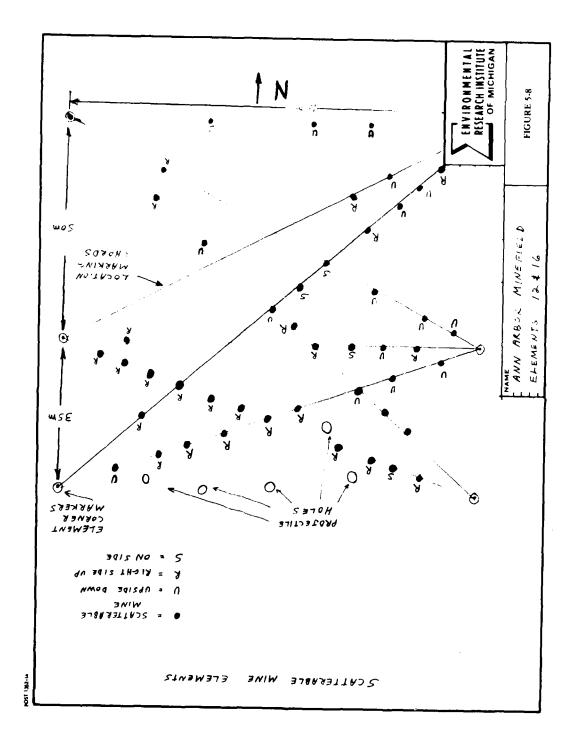












ERIM

5.2 MILITARY VEHICLES AND INFERENTIAL CHARACTERISTICS

In addition to test mines, other items of military equipment were obtained and used in the test array. A minelayer was obtained for use, and was generally located in the element with furrows. In addition several military vehicles and decoys were obtained from the U.S. Army Tank-Automotive Research and Development Command (TARADCOM). The vehicles included an armored personnel carrier, a 2 1/2 ton truck, a jeep, and an M-60 tank. The decoys were mainly to simulate radar characteristics and consisted of metalized inflated balloons, various shell casing configurations, a camouflage net and prefab boxes.

Other identifying features that appear in some minefields were incorporated into the scene. A 200 m barbed wire fence was installed on the south edge of the buried mines in elements 6 and 7. The vehicle traffic involved in the logistics of setting up the various elements caused lanes and ruts to be formed in the field. Other tracks caused by the heavy military vehicles were also evident in the field. Also foxholes were incorporated near one of the elements where decoys and military vehicles were situated.

5.3 GROUND TRUTH

As an aid in the analysis and interpretation of flight test imagery or ground-based imagery collected for the test array, it is essential that extensive ground truth be collected before and during each test. On site photos were then taken of the test array during the program. Two sets were made, one for MERADCOM and the second for ERIM. Equipment and facilities were provided at the test array for collection and recording of the following types of information:

5.3.1 WEATHER INFORMATION

Data were collected at the site for the following parameters:

Air temperature Precipitation

Wind direction

Wind speed

Cloud cover data (percent cover, cloud types, cloud heights)

In addition to measurements made at the test array, data were collected from other sources. The National Airport Weather Sequence was collected from nearby University of Michigan Weather Station located in Ann Arbor. (See Appendix B).

5.3.2 TERRAIN CONDITIONS

Data were also collected on the following terrain conditions:

-Soil moisture content

-Vegetation

Cover types

Plant height

Plant density

5.3.3 CALIBRATION DATA

Certain types of ground-based data are required as a means for calibrating the airborne sensors under test. These items were mainly contained in element 11.

Calibration data for temperature sensitive sensors was provided by the use of special temperature calibration surfaces and devices. Several temperature reference panels were placed within the test array. Each panel was large enough to cover several pixels in the sensor image. A water pond of known temperature was also used for this purpose. A small heat exchange panel was constructed consisting of adjacent surfaces of black, white, and gray. Thermometers were placed behind each surface. The device was then placed on the surface of the ground. The three surfaces were several inches above the ground surface and effectively insulated from the surface thermally. The temperature of each panel was recorded before and during the flyover. A solar cell covered by a diffusing

screen was used to measure short wave daylight, and air temperature in the shade was also measured. This information is sufficient to extract the values of basic parameters which can be used in thormal modeling to extrapolate the test results to other conditions of environment and weather.

For tests of photographic or thermal imaging systems, gray-scale reference canvases and spatial resolution panels were placed in the test array. The spatial resolution panels can also be used for checking the spatial resolution of thermal imaging systems.

For calibration of radar systems, radar retroreflectors of known radar cross section were placed at various points in the test array. The radar targets included corner reflectors at each of the element corners throughout the array, metal cylinders on metallic ground planes (top hats), large surface no-return areas (metallic sheets) and large metal upside down cylinders ranging in size from standard 5 gallon to 55 gallon drums.

5.3.4 GROUND BASED IMAGERY

Thermal images of mines and background areas were obtained with a ground-based thermal imaging system. In addition, ground-based photography was obtained to record the exact conditions existing at the time of each overflight.

In order to investigate the ability to detect mines from the ground, other tests were conducted by obtaining color movie coverage from a jeep as it moved into and through a minefield. This coverage simulated typical ground observation of a minefield from a vehicle. Similar coverage at eye level for a walking man was also obtained.

TEST CONDITIONS FOR FLIGHT TESTS

Test Array No. 1 was used in a series of flight tests conducted during July and August 1979. These flights included the following:

- (1) Handheld Minicam, Piper Cub 19 and 20 July.
- (2) KS-87B photographic coverage, RF-8G 12 July, 27 July (Also attempted 25 July).
- (3) FLIR and KA-76 photographic coverage, Mohawk aircraft 19 July, 4 flights: 6 AM, 10 AM, 4 PM, and 9 PM; 20 July, 2 flights: 10 AM and 12:30 PM.
- (4) Passive infrared coverage with AAD-5 scanner, RF-4C 1 August.
- (5) Spotlight radar coverage with ERIM CV-580 aircraft \sim 1, 2, and 3 August.

In this section, test conditions are recorded for each of the above flights. The data presented include the location of mines, military equipment, instrumentation, etc., on the test array (Figures 6-1 through 6-12) and weather data. (Tables 6-1 through 6-4). Table 6-5 shows the times at which the various elements were completed in the test array.

FLIGHT IDENTIFICATION MOHNWK NIKERAFT]	HAND	-	EM!	EMP
DATE JULY 19,1919 TIME 6:00 AM AIR TEMP 58°	M·15 SURFACE	BURIED M-15	EMITY	CAMOU	DIMEDRAL
RECUPITATION LAST SHIL O REL HUM 75% WIND			*	EMP	TWO CORPELS
SIGED O DIRECTIM O CLOUD COVER 10 SOME GLOUND FOG IN SE. CORNER	PM-LO SULFACE	HAND BURIED PM-LO	EMPTY	EMP	FIVE GROUPS CREINGS INFUSED
			* * * * * * *	APC 113	ONUTS (NFLATED DONUTS
	M-19 SURFACE	MACHINE BURIED M-15	REFERENCE ARRAYS	E He	x }
Annual Contract of the Contrac			#1 pond	บิ	S S
FOREST AREA	EMPTY	PLOW FURROWS	EMITY	&MPT	a la

U	M-19 SURFACE	MACHINE BURIED M-15	REFERENCE ARANYS POND #2 POT STEED GRAY SCALES D D D D	No.	ح)
	M-19	BURIED	ARLAYS	☐ FO	x \{ \}
	7 REPLACED DULING FLIGHT	PM 40	* * * * * * * *	EMP APC 113	INFLATED DUNVIS INFLATED DONUTS
DIRECTIM S.W. CLOUD COVER D	PM-60 SURFACE	HAND BURIED	* Q * * * * * * * * * * * * * * * * * * *	RECTAPHE EMP	MISC CASINGS FIVE GLOUPS MASINGS
TIME 10:00 MM AIR TEMP 74° PRECIPITATION LAST XY NL O REL HUM 50% NIND	M-IS SURFACE	BURIED M-15	EMPTY	SCLEEN	DIHEBEAL
FLICHT DENTIFICATION MOHAWK AIRCRAFT	•	SURFACE MINES HAND	 - 	EMP	EMP

FLIGHT IDEMINICATION	-	SURFACE MINES	0	EWL	EMP
MOHAWK AIRCE	i	HAND BURIED	HAND BURLED MINE CHORD	EMP	EMI
TIME 4:10 P.M. AIR TEMP 82° F PRELIPITATION	SURFACE	## M-15	M-15	S CREEN	\$1 \$ C O EA L
REL HUM 5690 WIND			IN blockers	EMI	CORNERS
DIRECTION SE CLOUD COVER O	1 M-60	STEERING STE	EMPTY	# RECTIME	MISC. CASINGS
	SURFACE 1	HAND	* * * * * * * * * * * * * * * * * * *	EMP	CUSINGS CASINGS
		₩- 6 0	* * *	EMI	BONTS
				A1C 113	INFLATES DONUTS
Muna.	M-19 Surface	MACHINE BURIED M-15	REFERENCE AMAYS	Hora Lox No	را الماراد المارد الماراد الماراد الماراد المارد المارد الماراد الماراد المارا
A SA			0 0000 6-was corres		maderial
ST AREA	EMPTY	FURLOW S	S CATTER MINES	91	the state of the s
FOREST		To the same			

TIME 9:10 PM AIR TEMP 67° F RECLIPITATION LAST 24 NL O REL HUM 70% WIND	ļ	M - 15	MINE CHORD M-15 LINE I IN PROGRESS	SCASEN SCASEN EMP	DIBEBLAL COLNELS
DIRECTION CLOUD COVER	PM-60 SURFACE	HAND BULLED	* <u>EMPT</u>	EMP	MISC CASINGS FIVE GROUPS OF CASINGS
			* * * * * * * * * * * * * * * * * * * *	APC 113	DONUTS INFLATED DONUTS
Munnay A	M-19 SURFACE	MACHINE BULLED M-15	REFERENCE ARMYS POND H2 GANY SALE O O O O	HOTE:	مىلىدىرىلىمىيىن [.] ئىمىردىمىلىدرمىلىنىك
IREA	EMPTY	PLOW FURLOWS	SCATTE MINES	9 2	طررورورو

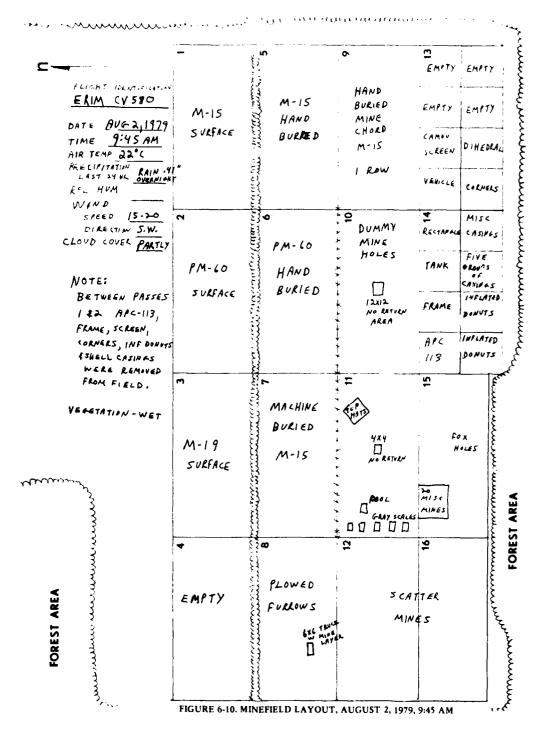
	_	MISC MINES	0	<u>m</u> Enp	EMP
MOHAWE AIRCAND	1	HAND BURIED	HAND BURIED M-15	EMP	EMI
TIME 10:00 AM AIR TEMP 66° F PRECIPITATION	SURFACE	M-15	MINE CHORD IN	CM+U SCREEP	DIH EDRAL
REL HUM 72 WIND		Taraca Tara Tar	LIN6	EMP	CORNERS
SPEED B DIRECTIM CLOUD COVER CLEAR	8	9	* <u>0</u>	ZECTANGE	MISC E SISWGS
CLEAR	PM-60 SURFACE	HAND GURIED	DUMMY	EMPTY	S OROUTS OF CASINGS
	DUN RCE	[] [M-60	HoLES	EMP TY	INFAM TED
			** ** **	A1 c	WFLATER
	m	L CONTRACTOR OF THE CONTRACTOR	=	5	er L
	M-19	MACHINE BURIED	REFERENCE ALLAY	No Fox	Linkow
rozwy	SURFACE	E 4 15		HOLES	and and
_y y y y y y y y y y y y y y y y y y y		M-15	GANY SCALE		mornina
	*	} co	5	5	- du
AREA	EMPTY	PLOWED	SCAT MINI		لسويدييديي
FOREST TO THE STATE OF THE STAT					7 4

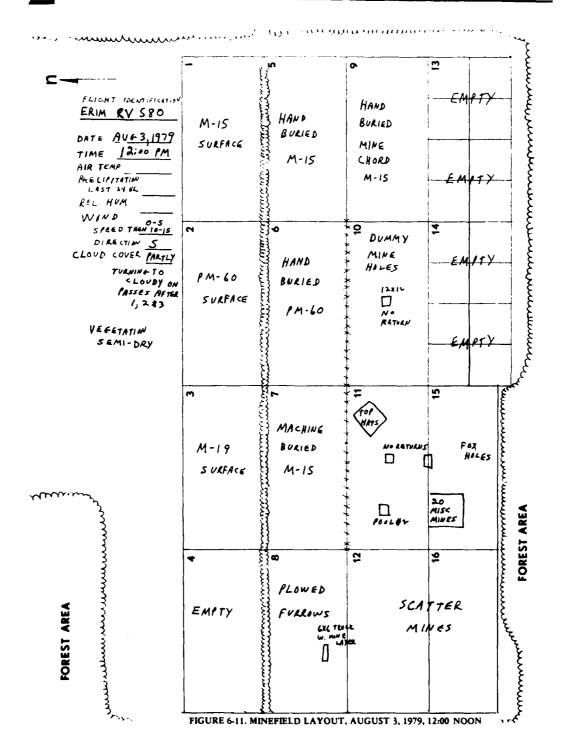
	! -	in 20 MISC	٥	5	
•		MINES		EMP	EMI
ACHIENT DENTIFICATION ACHIEWE ALROANST DATE JULY 201979	M-15	HAMP	HAND BURIED MINE	EMP	EMP
TIME 12:30 PM AIR TEMP 82°F REELIPITATION	SURFACE	BULIED M-15	CHORD M-15	CAMOU	DIN EDRAL
LAST 24 NL O REL HUM 40%		A COLUMN TO THE PROPERTY OF TH	LINE	EMP	CARNERS
STEED D DIRECTIM CLOUD COVER CLEAR	2	•	<u></u>	RECTANAL	MISC CASINGS
•	1M-60 SURFACE	HAND BURIED	* BUMM) * MINE * HOLES	MWE LAYER	FIVE GROUPS OF CASINGS
		PM-10	* //	EMITY	INF. DONUTS
				81°C 113	INF. DONUTS
	M-19 SURFACE	MACHINE BURIED M-15	- LEFERENCE ALLAY	No fox Hales	The continuous and the continuou
44 44 44 44			FRAY SCALE		and and a
FOREST AREA	EMPTY	PLOWED FULLOWS	S CATTE MINE	1	المراديدين والمهموم

Market Samuel Comments	SURFACE M-19	MACHINE BURIED M-15	REFERENCE ARANIS	D PO X HOLL]{
CLOUD COVER 100% CLOUPY ALL DAY PHOTO COVERMENT NOT SUCCESSFUL	SURFACE PM-66	HAND BURIED	DUMMY MINE HOLES	M-60 TANK WOOD FRAME APC 113	CASINGS FIVE GROUPS OF CASINGS INF. DONN'TS
PLICHT IDENTIFICATION RV 8 DATE 7-25-79 TIME 12:00 NOW AIR TEMP 74° F PRELIFITATION LAST 24 HL 25" REL. HUM 927. WIND SPEED DIRECTION	SURFACE M-15	HAND BURIE D M-15	HAND BURIED MINE CHORD M-15 J LINE	CAMOU STREET VEBICLE	CORNERS

	-	, in	<u> </u>	<u></u>	·
	1	1	ı	MINE LAYER	EMP
FLIGHT BENTHERATION	ri H	**	HAND	سينينين	
	M-15	HAND	BURIED	EMP	EMP
DATE 7-27-79	SURFACE	BURIED	MINE	(MOU	
TIME E/1:00 AM	3027 1102	M-15	M-15	SCREEN	DINEORAL
AIR TEMP 26° C		£3			
LAST 24 NL		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	I LINE	VENICLE	CORNERS
KEL HUM					
S/EED 10	8	50	<u></u>	4	MISC
CLOUD COVER PARTLY	-	E LL	*	RECTANGL	CASINGS
		HAND	MINE		FIVE
EARLY FOR CLÉARING IN	PM-60	BURIED	HOLES	M-16	PROUPS
AFTERNOON	BULFACE	DUELED	† D	TANK	CASINGS
731	DUAFACE	EPM-60	<u>†</u> 1	WOUD	BONUTS
	1	\(\)	RABAR	FLAME	DOP-13
		3	RETORM	APC	INF.
		[]	\$	1/3	DONUTS
	М	1	* =	15	Ę,
			REFERENCE	ļ	٤
	M-19	MACHINE	ARRAY	, Fo	ع ا
	m-17		TOP HATS	1	LES E
	SURFACE	BURIED	† n _	Ф	٤
		M-15	: "	Ī	18.
کیمیرید، وی		3	RETURN	3.0	
3		<u>}</u>	DEAN SCALE	AL EC MINES	
\$!	* 00000		}
ž	4	\$} co	12	5	—— { E
N.W.	F4. 0 m24	E	1	}	\ <u>\</u>
3	EMPTY	PLOWED			}
RE >		FURROWS		TTER	{
₹ }		₹	MIA	155	کم ا
FOREST		{ }			
9 3		\$ ***	İ		
· 3		\$	1	1	1

	-		٥	M EMPTY	EMPTY
FLIGHT DEMISICATION ERIM CVSPO	M-15	M-15	MINE	£Mfty	EMPTY
DATE <u>AVG 1,1979</u> TIME <u>9:25 AM</u> AIR TEMP	SURFACE	BURIED HAND	(ORD ROW	CAMOU	DIBEDRAL
RECIPITATION LAST 24 NL 75 IN. REL. HUM		14111 CANA		VEHKLE	COLVERS
WIND SPEED DIRECTION CLOUD COVER 100%	7	9	. 0	T RECT	MISC CASINGS
	PM 60	PM-60	* DUMMV * MINE	TANK	FIVE GROUPS OF CASINGS
	SURFACE	BURIED	HOLES	FRAME	INF.
			*	APC 113	INT. DONOTS
	m	7	‡ =	5	Er.
	M-19 SURFACE	MACHINE BURIED M-15	SAME A 7-27-	ł	ه معمور معموم معمور معاد
A Survey of Surv			* * * * * * * * * * * * * * * * * * * *		بدشمدتهممه
AREA	EMPTY	PLOWED FURLOWS	SAME 7-27-	i e	لتوريديديديديديديديديديديديديدي
FOREST					1





عود و ۱۹۰۰

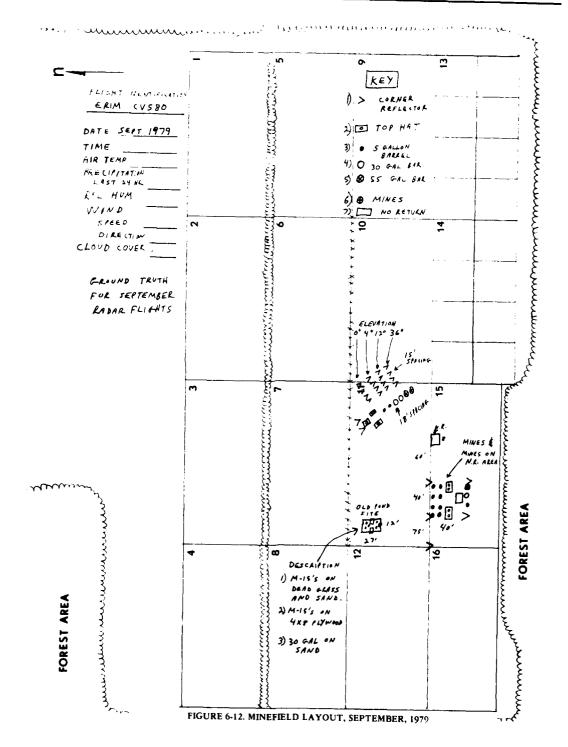


TABLE 6-1
GROUND TRUTH TEMPERATURES, °C, FOR OV-1D (MOHAWK) FLIGHT
ANN ARBOR TEST SITE, 19 JULY 1979, 11:00 AM

		1	TEST S	SAMPLES		
		1	2	3	<u>4</u>	
1)	Unpainted M-15's Element 5	43°	40°	41°	44°	
2)	PM-60's Element 5	51°	50°	50°	53°	
3)	Scattermines Element 5	36°	36°	24°*	37°	
4)	Painted M-15's Element 5	40°	41°	41°	41°	
5)	M-19's Element 5	38°	38°	38°	44°	
6)	Water Pond Element 11	20°	20°	21°		
7)	Air Temp. Element 6					
8)	Heat Exchange Panels Element 11	White Gray Black	22° 32° 54°			
9)	Gray Scale Panels	White 1 38° 38°	2 45° 45°	3 48° 47°	4 50° 52°	Dark 5 50° 52°
10)	Hand Buried M-15's	35°	32°	35°		
11)	Hand Buried PM-60's	48°	46°	49°		
12)	Back Ground High Low	20° 23°	40	43		
	Machine Buried M-15's	32°	38°			

^{*}Unpainted and Shiny

TABLE 6-2.

GROUND TRUTH TEMPERATURES, °C, FOR OV-1D (MOHAWK) FLIGHT ANN ARBOR TEST SITE, 19 JULY 1979, 4:00 PM AND 9:15 PM

		1	TEST SAMPLES
1)	Unpainted M-15's Element 5	52°/18°	52°/18° 52°/20° 50°/18°
2)	PM-60's Element 5	60°/17°	58°/16° 59°/17° 58°/17°
3)	Scatter Mines Element 5	45°/18°	46°/20° 20°/17°*41°/19°
4)	Painted M-15's Element 5	50°/20°	50°/20° 51°/18° 52°/20°
5)	M-19's Element 5	48°/16°	50°/16° 48°/16° 49°/16°
6)	Water Pond Element	37°/25°	30°/22° 31°/21° 36°/20° 32°/22°
7)	Air Temp Element 6		
8)	Heat Exchange Panels	White Gray Black	30°/15° 55°/14° 56°/16°
9)	Gray Scale Panels Element 11	White 1 40°/10° 40°/10°	Dark 2 3 4 5 48°/11° 52°/10° 54°/12° 58°/12° 48°/10° 50°/10° 56°/12° 58°/12°
10)	Hand Buried M-15's	54°/16°	53°/16° 52°/16°
11)	Hand Buried PM-60's	41°/15°	61°/16° 63°/15°
12)	BackGround	High Low	23°/14° 30°/14°
13)	Machine Buried M-15's	None	30 , 14

^{*}Unpainted and Shiny

TABLE 6-3
GROUND TRUTH TEMPERATURES, °C, FOR OV-1D (MOHAWK) FLIGHT ANN ARBOR TEST SITE, 20 JULY 1979, 10:00 AM and 12:30 PM

		_	TEST SAMPLES
		1	2 3 4
1)	Unpainted M-15's Element 5	22°/58°	30°/56° 34°/54° 34°/48°
2)	PM-60's Element 5	39°/69°	38°/66° 38°/64° 38°/66°
3)	Scatter Mines Element 5	22°/44°	21°/48° 8°/20°* 20°/40°
4)	Painted M-15's Element 5	33°/54°	33°/56° 32°/55° 34°/56°
5)	M-19's Element 5	28°/60°	25°/60° 27°/58° 38°/62°
6)	Water Pond Element 11	18°/26°	18°/30° 20°/32° 19°/28°
7)	Air Temp. Element 6		
8)	Heat Exchange Panels	White Gray Black	24°/36° 37°/60° 42°/66°
9)	Gray Scale Panels	White I 24°/44°	Dark 2 3 4 5 28°/56° 31°/59° 32°/63° 30°/65°
10)	Hand Buried M-15's	26°/52°	26°/44° 22°/48°
11)	Hand Buried PM-60's	30°/44°	32°/60° 24°/68°

^{*}Unpainted and Shiny

TABLE 6-4.

GROUND TRUTH TEMPERATURES, °C, FOR RF-4C FLIGHT,
ANN ARBOR TEST SITE, 1 AUGUST 1979, 11:00 AM

				SAMPLES		
1)	Unpainted M-15's Element 15	1 30°	2 29°	<u>3</u> 0°	4 30°	
2)	PM-60's Element 15	34 °	32°	32°	34 °	
3)	Scatter Mines Element 15	22 °	26 °	28°	28°	
4)	Painted M-15's Element 15	29 °	29°	30°	29°	
5)	M-19's Element 15	32°	30°	30°	31°	
6)	Water Pond Element 11	20°	20°	20°	20°	
7)	Air Temp Element 6	25°	2 4°			
8)	Heat Exchange Panels Element 11	White Gray Black		23° 34° 34°		
9)	Gray Scale Panels	White 1 24° 25°	2 28° 29°	3 30° 30°	4 32° 32°	Dark 5 34° 34°
10)	Hand Buried M-15's Element 5	20°	18°	24°		
11)	Hand Buried PM-60 Element 6	26 °	26°	28°		
12)	Background	High Low	18° 22°			
13)	Machine Buried M-15's	26°	26°	28°		

TABLE 6-5
SCHEDULE OF MINEFIELD TEST COMPONENTS

Element	Contents	Date Finished
1	Painted M-15 surface Mines spaced at 25' intervals	07/18/79
2	PM-60 surface mines spaced at 25' intervals	07/18/79
3	M-19 surface mines spaced at 25' intervals	07/18/79
4	Empty	
5	M-15 hand buried mines spaced at 17' intervals	07/05/79
6	PM-60 hand buried mines spaced at 17' intervals	07/06/79
7	M-15 minelayer buried mines spaced at assorted intervals	07/08/79
8	A) Open and closed mine furrows2 of each alternating rowsB) Short open furrow	07/08/79
9	A) M-15 hand buried mine in mine cord pattern in SE corner only	
	* B) 20 misc surface mines C) Large radar corner	07/19/79 08/03/79
10	A) Dummy mine holes spaced at 25' intervals	07/26/70
	B) No return areas (12' x 12')	07/26/79
11	Tophats No return areas (4' x 4') ** Pool #2 (12' x 12') Canvas panels	08/01/79 07/26/79 07/19/79 Set out for every flight

^{*} The 20 misc surface mines were moved to element 15 on 07/26/79

^{**} Pool #1 was built on 07/18/79 then torn down and replaced with pool #2 on 07/19/79

TABLE 6-5. (Continued)

Element	Contents	Date Finished
12	Scatterable mines spaced in assorted patterns and intervals	07/19/79
13	Screen Radar Corners US Army vehicle Aluminim angles	07/19 & 20/79
14	Rectangle Shell casing (misc) INF donuts Frame Tank APC 113	07/19 & 20/79
15	20 misc mines No return area (8' x 8') Four foxholes	07/26/79 07/26/79 07/23/79
16	Scatterable mines	07/19/79
Misc	Fence posts Radar corners on ground by fence posts Radar corners on fence posts Barbed wire fence	07/11/79 07/26/79 08/03/79 07/10/79

APPENDIX A

ASSESSMENT OF MINE CHARACTERISTICS

This appendix contains four memos discussing measurements and analyses of mines carried out to test the equivalency of the simulated PM-60 to the real PM-60 and the M-15 U.S. antitank mine to the TM-46 Russian equivalent. Conclusions reached from these measurements and analyses are summarized below.

1. Memo, E. L. Johansen to H. McKenney, 23 May 1979, "X-Band RCS Measurements on New Simulated PM-60".

Radar cross-section measurements were made of a new simulated PM-60 and a real PM-60 filled with wax. The measurements indicate that the simulated PM-60 has the same mean cross section as the real PM-60 and is therefore a good replacement for it in the mine arrays for measurements with imaging radars operating in X-band.

2. Memo AD-DB-331, D. Bornemeier to H. McKenney, 22 May 1979, "Simulated PM-60's".

Inspection of the simulated PM-60 indicated that the electro-optical response should be similar to the real PM-60 if two coats of paint are applied to the simulated PM-60. For thermal simulation, the similarity is questionable since the present fill of the simulated PM-60 is only about 11 lb. compared to 25 lb. for the real mine.

3. Memo AD-DB-509, D. Bornemeier to H. McKenney, 22 October 1979, "Thermal Match of PM-60's".

Measurements were carried out to estimate the degree to which the simulated PM-60 mines simulate the thermal response of the real PM-60's. Since a real PM-60 was not available, for comparison, it was represented by filling an empty dummy casing with toluene to simulate the thermal characteristics of TNT and a thin air bubble

was incorporated at the top, similar to that contained in the real mine.

The toluene-filled PM-60 and wax-filled simulated PM-60 were then placed on open grass and observed frequently with an 8 to 14 μm radiometer during both cloudy and sunny weather. The observed temperature difference did not exceed 3°C, and was mostly less than 1°C. It is concluded that the simulated mines are adequate thermal representations of the real PM-60's.

4. Memo SP-79-692, D. Bornemeier to H. McKenney, 13 December 1979, "Results - TM-46 Measurements".

Radiometric measurements at 8 to 14 μm were made during December on a real TM-46 anti-tank mine, a simulated PM-60, and two inert M-15s painted to match the TM-46. The M-15s were found to give a good thermal approximation to the real TM-46. However, the TM-46 has noticeably less thermal inertia than the M-15.



23 May 1979

MEMORANDUM TO: II. McKenney

FROM: E.L. Johansen

SUBJECT: X-band RCS Measurements on New Simulated PM-60

Project 138331

We recently received two new simulated PM-60 mines from the manufacterer. With the rotary platform instrumentation, we made cross-section measurements of the new simulated PM-60 and of a real PM-60 filled with wax. The center frequency of the measurements was 10 GHz and the depression angle 3°. The polarizations were vertical and horizontal.

For the measurements the returns of the simulated PM-60 and the real PM-60 filled with wax were recorded as the platform rotated. For both polarizations the mean cross section of the simulated PM-60 differed from the cross section of the real PM-60 by less than one or two dB. The fine grain structures of the two mines were somewhat different; the cross section of the real PM-60 varied more rapidly but this small difference is not significant.

The cross section measurements indicate that the new simulated PM-60 has the same mean cross section as the real PM-60. The new simulated PM-60 will, therefore, be a good replacement for real PM-60's in the mine arrays for measurements with imaging radars operating in X-band.

ELJ/vo



ANALYSIS DEPARTMENT

22 May 1979 AD-DB-331

To:

H. McKenney

From:

D. Bornemeier

Subject: Simulated PM-60's

I have inspected the prototype PM-60's (two) received from the manufacturer last week! They appear to be adequate as regards the expected similarity of EO responses from them as compared to real PM-60, with the following reservations: (1) At least two coats of paint should be applied according to Lafferman (MERADCOM), and (2) the mines with the present fill are only about 11 1b compared to 25 1b for the real mine.

This later point is not important for active EO simulation, but may be for thermal (passive IR). There is however no requirement that the thermal and radar properties be simulated simultaneously. A quick measurement using a hand-held radiometer to compare the 8-14 response of a real PM-60 and a simulated PM-60 would resolve this question.

cc: J. Beard



ANALYSIS DEPARTMENT

22 October 1979 AD-DB-509

To:

H. McKenney

From:

D. Bornemeier

Subject: Thermal Match of PM-60's

Measurements have been carried out to estimate the degree to which the existing PM-60 surrogate mines represent (from a thermal response standpoint) real PM-60's. A real PM-60 with TNT charge is not available for comparison; hence, some compromise in the comparison was necessary. Outlined below is the procedure used to estimate thermal match and the results.

The present set of mines were made to simulate radar responses of the real mines. As such, they were filled with S 446 wax (Shamrock Chemical Company product) which had the proper dielectic properties. A thin, 3/8 to 1/4 inch thick, air bubble like the real mine was incorporated at the top (between the wax and the inside) in the dummies. Upon inquiry, Shamrock was unable to state the thermal conductivity or specific heat of the S 446 wax. Hence no direct theoretical comparison of the wax and TNT could be made. A search however revealed that toluene has thermal properties similar to TNT. It was therefore decided to simulate a real PM-60 by filling an empty dummy casing with toluene to simulate the thermal aspect of TNT and the air bubble.



To: H. McKenney Page 2

22 October 1979 AD-DB-509

A dummy casing was coated inside with two coats of polane (TM), a material resistant to toluene (the Norel plastic of the case is dissolveable in toluene) and dry baked in a microwave oven. The mine was then filled with toluene such that when the mine was flat (bottom down) a bubble of the same shape and size as those in the wax versions was formed.

The mines, wax filled and toluene filled, were then placed on an open grass terrain and observed frequently with an 8-14 Am Barnes PRT-5 radiometer. Over a period of five days, including cloudy and sunny October days in Ann Arbor, the observed equivalent temperature difference did not exceed 3°C at any time. The differences were for the most part a degree or less. There were no especially sharp changes in the thermal driving functions during this time; hence, the fast transient thermal response which might occur on a hot July afternoon followed by a heavy cold rain were not tested. However, it appears that for practical purposes the present mines are adequate thermal representations of real PM-60's for the purposes of the IR detection studies.

13 December 1979 SP-79-691

MEMORANDUM TO: H. McKenney

FROM:

D. Bornemeier 1.1) %

SUBJECT:

Results - TM46 Measurements

During the week of 3-7 December, radiometric measurements were made on a real TM46 anti-tank mine, AMFRADCOM PM-60 surrogate and 2 inert M-15s which were painted with US olive drab to match the TM46. The purpose of the measurements was to compare the thermal response of the surrogate mines with that of a real mine under more or less nominal environmental driving functions.

Fortunately two good consecutive days of thermal data were acquired. The weather was clear and sunny and on the mild side for December at MERADCOM (Ft. Belvoir, VA). Measurements were carried out inside a double "fenced-in" area at the engineering proving grounds at MERADCOM. The mines were laid out on a short grassy terrain and a PRT-5 portable radiometer measuring in the 8-14 µm band was used to gather data. The summarized raw-data is given in the accompanying tables. The temperature-adjacent terrain are shown in the attached figure. The M-15 data is the average of the two M-15s.

As can be seen from the curves, the M-15s do give a good approximation to the real TM46 with respect to thermal response. There is, however, a noticeable difference. The TM46 has less thermal inertia, i.e., the real mine warms up faster and cools down faster than the sand filled probably represent quite closely what could be expected if real mines will were used. It is possible that a wax fill like that used for the PM-60s this later investigation be carried out.

DB/vo

cc: R. Nalepka

Y. Morita

PRT-5 READING ON LAND HINES

Fort Belvoir, VA 12 03/79

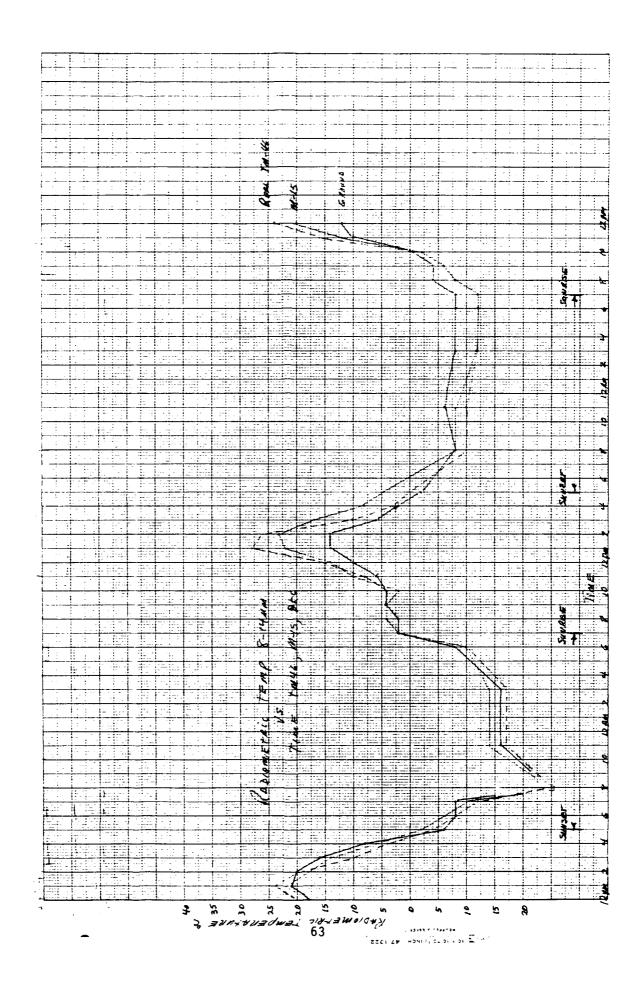
Time	M15	T214-6	<u>M15</u>	<u>PM60</u>	Air Temp	Ground	Comments
12:00 pm	18°C	20°C	18°C	21°€	43°F	18°C	Sunny
1:00	22	24	21 .	26	50	21	Sunny
2:00	18	20	18	22	50	20	Sunny
3:00	14	10	14	14	48	16	Sunny
4:00	6	4	6	6	45	8	Sunny
5:00	-2	-4	-2	-8	35	-6	Sunset
6:00	_f ,	-8	-6	-10	35	-8	Clear
7:00	-10	-12	-10	-12	3.2	-3	
8:00	-50	-50	-50	-50	25	-50	Mines & grass wet/ bad battery —
11:00	-14	-17	-14	-16	32	-16	Cold, damp
3:00 am	-14	-17	-14	-16	32	-15	Cloudy
6:00	-10	-10	-10	-8	32	-8	Frosty
7:00	2	2	2	. 4	32	2	Sunrise, frosty
8:00	4	4	4	4	32	2	Frosty
9:00	4	4	4	4	32	4	
10:00	2	4	2	4	40	4	Partly cloudy
11:00	10	8	10	12	45	6	Sunny
12:00 pm	14	16	14	16	50	10	Sunny

PRT-5 READING ON LAND MINES

Fort Belvoir, VA 12/04/79

Time	<u>M15</u>	<u>T214.6</u>	1115	PH60	Air Temp	Greu id	Comments
12:00 pm	14°C	16°C	14°C	16°C	50°F	10°C	Sunny/clear
1:00	22	28	22	26	52	14	Sunny/clear
2:00	22	26	24 .	26	52	14	Sunny/clear
3:00	14	10	12	10	48	5	Sunny/clear
4:00	8	8	3	6	45	2	Sunny/clear
5:00	4	0	4	2	42	-2	Sunset
8:00	-8	-10	-8	-12	25	-8	Clear
11:00	-8	-10	-9	-8	23	-6	Clear
3:90 am	-12	-12	-12	-12	20	-8	Clear
6:00	-12	-12	-12	-12	20	-8	Frosted
7:00	-12	-12	-12	-10	20	-8	Frosted
8:00	-8	-3	-9	-8	25	- '	Frosted
9:00	-6	6	-8	-6	32	-4	Sunny/clear
10:00	-2	-2	-2	-2	37	0	Sunny/clear
11:00	12	16	12	18	48	10	Sunny/clear
12:00 pm	20	24	20	24	50	12	Sunny/clear

^{*10} mph wind out of southwest



171 3 100

APPENDIX B

METEOROLOGICAL DATA

Appendix B contains a record of weather observations in the Ann Arbor area during the flight test period, as provided by the University of Michigan Weather Station located in Ann Arbor.

		ı		11110	MICHIGAN	Jacy "-1	1									RATIONAL BEAT SENTENCE
<u> </u>	HIVER	1		TVPE	OF RIVER GAGE	COUNTY					FF	FIGURE B	- ;			
٠	TIME (facel) OF DESERVAT	MERNATH	ION RIVER	TEMPE	TEMPERATURE PRECIPITATION	<u> </u>	<u>.</u>	(a) RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS	ORD OF	RIVER	ղ 2	IMATOL	OGICAL	OBSERV.	TIONS	
150	STATE PRITE 1115 FIN	Г	GAGE ZERO	OF RIVE	IN PLOOD STAGE	1	T -		,							
_	RIVER STAGE	٤	PERATURE			ł		#EA	WEATHER (Calandor Day)	ander Day	L	PECIAL O	SERVAT	ONS OF PR	SPECIAL OBSERVATIONS OF PRECIPITATION & RIVER STACES	RIVER STAGES
		24 H BS	24 HRS. ENDING	-	Draw a straight line (through hours precipitation	М	24-HR AMDUNTSA	Ob.MARK 'X' FOR ALL TYPES	Y FOR	11, 17, 18		_	MO	RIVER	CREST STAG	E, DATE AND
	MOI PER	98	AT AVATION O	OBSK.	recipitation probably securi		tod , lied , tohnel	20 pal. 11, 160 10 pal.	511	DNIS	.nedO	AC OITAVE	MA V			ICE, STATE OF WEATHER AT TIME OF DBSERVATION
1	LIONO	¥			2	1234567891011	,wanż pallag (Ins. &	904	פרענו שנירו	THUNG	SONIW P em.]	DATE SMIT	PRECI	¥	TEND	
:1 <u>-</u>		13	85	1		25.0 111111111111111111111111111111111111		\overline{x}	+			L				
ات.)		73	\vdash	1 1	1 14444	111111111110.02	17	×								
لتا :		7.1	Н	2					-			-		1		
۲		74	Н	74 1	#	28.0	- ا	1	1	X	1	$\frac{1}{1}$	\Box	1		
드 :		714	1	5		0 11 11 11 11 11 11 11 11 11 11 11 11 11	+	7	+	+	†	+	1	1		
-1		75	+	74		0	1	7	+	+	1	+	1	+		
نا:		78	+	,,		0	+	+	+	+	1	+	1	\dagger		
	† 	29	+			0	†	7	+	+	+	+	1	†		
		7 6	3 8	1		5.0	+	4	+	‡	+	+	-	\mid	-	
:		6	t	t		5, 0	1	×	Ť	×	1	\vdash				
	2	×	+-	1 2	110168 69 9 6 2 1	V 2 3 4 3 6 7 8 9 10 11 0. 74	5	×			L	\vdash				
! 		38	╁╴	28		0 11 11 11 11 11 11 11 11 11		×								
_	[4]	8.4	H	8.4				×		×						
= 1	-	85	2	28			9	X	+	+	1	+		1		
_	2	8,4	+	+		0	+	+	+	+	1	+	1			
=1.3		8/	+	23		1	+	7	+	+	1	+	1			
		2 5	24 5	75			+	+	+	+	1	+	-	Ì	-	
15	20	3	7 5				+	+	+	+	‡	9	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	IS HEEDE	IF MORE SPACE IS MEEDED, USE ADDITIONAL FORM	AL FORM
	 - -	83	3	2				×	F	F	Ē	REMARKS				
:	n	85	┝	7.8	1 2 3 4 5 4 7 8 9 10 11	D 110148 / 95 7 7 1	-	×					9	Local Branchister of Paris		18 80 CE 80 M '81 '11'
	a	3,6	Н	2%				X					,		See June 1988	Commercial in
~1	2	85	63	7.		計		1	1	7	7	à		1 1/2	BOXBORD ABL. Flood compy to conde, Bridge, famous	man, cagaina,
ـــــــــــــــــــــــــــــــــــــ	n	17	+	12		57.0111111111111111111111111111111111111	100	X	7	7	Ţ	Menda.sh	E . 14 - 1	dnighr Ca	Midnight - re-Midnight (621) inax /min Teme	78ms1
Ň	×	78	+	77		10.03	7 7	X:	+	+	7	1. max : 62	ı		04.160	
<u> </u>	a	83	+	20		0	1	*	+	#	Ţ	P. BAR. 34	7 1	7:	mac 78, musc)	
<u> </u>		2	٥	7		0 0		1	+	‡	Ī	S. Marra 13	2 5		01	•
15	:	3	†	1/2		HIII HIII 10.07	Ĭ	×	F	×	Ė	S mare 85	ש		F - 77	
.ح.		2.5	7,			111111111111111	- -7	×		×		N. Max . ES				
<u></u>	3 nw	08/17X	1857	M	CONDITION OF RIVER			X		1 1	•	152 - 34W CI	È	2		
<u> </u>	READING DATE	DA TE	NORMAL CR. BAR		B. Freson, but open of gogs.		1 72			THE PROPERTY OF	98	OBSERVER	10	C PANALS C	Kaminan	
	Ave. Plat. 80 0	Exm	¿w.ę	Ī	E. Ico garge above gage.	UPERVISING OFFICE			STATION INDEX NO	INDEX IN						
اخا	Ave min 59 9		May . 86		O. Fleeting Ice.	•			_		((
_	A12 01800 70 0	Ì	may: 47		J. 1961 11086.	FLAN FIRMOR, 1114					9	֖֭֡֜֝֜֝֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜				

FIGURE B-1. (b) RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS
WEATHER ICANNOL Day) SPECIAL OBSERVATIONS OF PRECIPITATION & RIVER STACES
T BIVER
od Oben. meri irm
SINCE TIME OBSE
X
X
X
×
X
IF MORE SPACE IS MEEDED, USE ADDITIONAL FORM
A control of the cont
Tabooba /w/ompt sound in the same X
7
Midryht-tp. Mydit (65T) Mac. /mia. Tomponated
1
m440 7L
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
CANADA CONSERVER
STATION WORLD
WSF0 20-0230-0
K.

WALES COUNTY CO	•	STATION	Chargo	96/481)		è	River Station, It dilibrant	r	V3 FORE E-15	۽					1		S. DEPARTMENT OF	OWNE
The control of the		B	IN Ar		4010.0	Y	CHILAN	-	il					ł			NATIONAL PEATHE	A SEAVIC
		A:<	ı	•			OF RIVER GAGE						FIG	.RE 8-				
TOO _	TIME (lea	0 40 (14	BERNATIC	M AIVER	TEMPE	RATURE PRECIPITATION		<u>ن</u>		ORD OF	RIVER AL	5	MATOLO	25.5	BSERVA	TIONS		
							0061 1001	_	_									
	-	STATE m IC	7012		AGE ZERO	PAN I		NORMAL POOL STAGE	1				i					
1 1 1 1 1 1 1 1 1 1		RIVER	STAGE	TEMP	ERATURE	ŀ				WEA	THER IC.	inder Day)		ECIAL OBS	FRVATIO	KS OF PRE	CIPITATION & RIVE	RSTAGES
State Stat		L	\vdash	24 HRS.	ENDING	2.	iran a straight line (_	MOUNTS	6	Y FOR A	LL TYPES		*	MO	RIVER	CREST STACE, D	ATE AND
State Stat		HO.	ACE LDING	į			racipiralian probably occuri	herie	o: hed tenne	(lue.)	-	DM:	.ne 40	DITA	TAT!			EATHER RVATION
S			**************************************	3	7-	į	3	4	(1049) (1049) (1049)	9	32V	NVQ IF	300.0 90.0		4 30			
St 2						78		1 2 3 4 3 6 7 8 9 10 71	ing (m)	0.	פר	АН	#!) - -	+	SIN SIN	"		
8.2)	- -	$\mid \cdot \mid$	28	1	29		0	+	×	+	+	1	1	+	1		
1		<u></u>	+	28	+	2		0	1	× >	+	+	1	\prod	\dagger	+		
2 2 2 2 2 2 2 2 2 2		+	\dagger	3 5	╅				+	×	+	-	1	-	\dagger	\dagger		
S S C S C C C C C C	:		T	7	✝	33		0 1111111111111111111111111111111111111		×	+					-		
Sec. 5 1 1 1 1 1 1 1 1 1		-	-	83	۲	0				×						-		
C S C C C C C C C C			Н	&	Н	6.3									i			
25		-		65	-	58				-								
28 45 27	•	•	1	63	-+	83			1	-	#	1	1	1	1	1		
10	:		1	/3	-1	7				1	1	1	1	-	1	1		
1	••-	Ξ.	1	7,	\dashv	69		0		7	1	-		-	1	-		
1 29 49 65 10 10 10 10 10 10 10 1	•	=	1	18	4	78	101616161616161616161616161616161616161	7 0 6 10 11		-	+	-	1	-		-		
1	:	=	+	78	-	т.				X	+	+				+		
1		2	+	7,	-+	. т	1		7	×	+	+	1	1	1	+		
1	•		†	83	+	+			1	7	+	+	1	1	1	1		
13 53 76 11 11 11 11 11 11 11	:		\dagger	7	+	57			+	}	+	+	1		1	+		
1 1 2 3 3 4 1			+		+	2			+	4	+	+	1	1	1	+	+	
12 43 44 74 74 74 74 74 74			+	138	+	2			1	1	+	+	1	1	1	+		
1 1 2 4 4 4 4 4 4 4 4 4	:		+	2	+	9			1	,	+	$\frac{1}{4}$	1	-		-		
1 1 1 1 1 1 1 1 1 1	•		†	1	┿	1			+	₫: 	+	+	Ï	THAD KE	SPACE	S NE EDE	USE ADDITIONAL P	SK.
2 2 40 64	:	1 2	†		╌├╴	3			+	4	+	+	Ι	Foct wit	H VISid	ICITIES :	1mile: 1,3,5,13	29,30
23 43 72 1	:]	2	+	23	+-	63		£		+	 	+	I	TRW+ : 3,	פר			
10 10 10 10 10 10 10 10		-	1	73	┰	77				×		-		Scament				
1	-			77	Н	2		<u> </u>						Mior Lart		Ē	į	Jante 1
1 1 2 2 2 2 2 2 2 2	'n		H	2 <u>0</u>	Н	7.8							$\dot{\square}$	6. MAR . F.	, market			
57 64			1	73	-	73						-						
		2	1	73	-	63				×		-	Ì					
		2	+	8	+	29			1	X I	1	-	Ì					
		2	1	8	-	7				×	1	1	Ì	V. MAREES		o		
10 10 10 10 10 10 10 10			1						1	1		- ;	I	N. 1918-75				
1. STATION INDEX 110. STATION INDEX 110. AND AR 130R, 111 T. CUS F. C. A.O. O. A.S.O. O.		NO.	4	7877	7757		AT CACE	O mas Company	20	X	10	1=4	_			٥		
1. STATION INDEX 110. 1. SA C. Fueller III. AND AR 130R, 111 LUS FO 20-0230-0		READING		DATE		Ī	B. Fresen, but open at page	O THE STATE OF THE	7	-	63.0		OBSCR	ļ	7 W W 2	L.	000000	
Alar. 83 C. Flanten to. Ann Arior, 111 CUSFO		A. 110.	7, 7,	1		Ĭ	D. Its garge above gage.	SUPERVISING OF FICE		1	STATION	NDEX NO.						
MIN. 39 H. Parl 1800. ANN FRISCR, 1717 CUSTO		4 . 01.00	1	1	١,	Ĩ	F. Shore ice.											
		1000	642	L	49. 49	Ť	H. Paol stage.	Ann ARISOR,		٥		20-00	230-6	0				

TABLE B-1

SUPPLEMENTAL REMARKS

KEY FOR SUPPLEMENTAL REMARKS

L = Drizzle

RW = Rain Shower

R = Rain

TRW = Thunderstorm

'+' ≈ Heavy

'' = moderate

'-' = light

'XX' = severe

CLOUD EXTENT

O = clear 0 - 0.1

 \bigcirc = scattered 0.1 - 0.5

 Θ = overcast 0.9 - 1.0

RW - B0310E2030 = Light Rain Showers Began 3:10 AM Ended 8:30 PM F06 Vis = 1-1/2 mi 02 = 1-1/2 vis fog at 2:00 AM

SUPPLEMENTAL REMARKS, ANNARGOR, MICH, JULY 1979 All TIMES ARE EDT 1. Mas - 62, L- 60500, RW-80500 1015, OCH L-- BMODE 1300, RW- RKODE 1015 BK 45 E1715, FOR VILO Sm. 01,05, 3m. 05 2m. 06-08, 3m. 09-10, 4m. 11, 3m. 12, 4m. 13-15, 3-4m. 11-20, 5-6m. 21-24, @Sc 01-05, @Sc 5+06-24 2. MAYE 74, RW-BOOKSEUIIS, L-BYONSOFY 0900, God For APRIL DOOD, @SCOI-03, OSCBASON, OCERSOS, @Locid -805c 04, @ 5c10-15, @ Sc16, @ S. @ AKN, @ Sc18, @ Ch 19-22, O 24 HARE VI = Smi 09 3. OOI-06, @Acor-09, OAc 10-11, @Ac 13, OC DAC 13, OC BRIV-15, OC DACK-17, OAC 18-19, - OACCC 20, OAC 31-24 TRW-B0230 € 0300, Rw-E0200 € 0445, @Aco,-02, @Sc Aco, @Sc 04-09, @CL 10, O,1-12, -@Aco, -@Cu 14, @Cu 15 -19, @ Ga 20-23, Ozy 5. MAX = 70', OO,-11, OG 12-17, OG -OCITE, O19-24 6. O01-03, Da or-ox, Ooc-14, Da 15-16, Da Ca Dan, Oce 18-0, Da 224 O01-16, -DC17-19, -DC120-23, -DG24 HAZEVIL-6mily. E. O CEOI, OO2-OE, OCEMON, -O CEOS-ON, OCCID-15, -O CEE, -OCID-19, OAC-OC; W, DACOCEU, O CEOS-28, WAC 24 HARR Vue Gm: 17-19, 4-Sm: 20-23, 3m; 24 9. MAR = 73 , AU- BO445E DE 30 BOEIS CO530 BILLD E 1215 , AW-VRW-BIDDO E 1100 TRWBEISE 1400 ; @AC 01-04 , & AC 5-04 , Ø Sc ØAc 07-12, -8 € Sc 13-14, @ Sc 15-17, @ Cu 18, @ Cu 19, @ Cu 10, -@ Ac+1, + Cs 22, O23-24, FOC V13 + 21/2 mi c7-08, 2m. 09, 2 1/sm. 10, 3m. 11, 2m. 12, 1m. 13, 1 /vm. 14, 3m. 15-16; HAZEVIST Sm. 01-02, 6m. 17, 5m. 28 SER MPS. 66, SWATER SCO 10. Ob,-Oz, -80 Cuasou, Bos-ac, -Bor-10, - ODCui, Dais-15, Bak, -80 Cuis-20, -80 Ac 21-22, -0C: 23, 10-1034; FOG Y Foolings Vise 2mioy, 11/2mi05-06, 2mi07-08, 27/4mi09, 3mi10, 4mil, 5min; HAZEVAS SMO3, Smill-15, 6mill, 4mil7-20, 5mias, 4mias, 3mias-24 11. RW--@1210, RW-E1400E1415, TRW BIG30 E1655, TRW+BIB30E1900, TRW-B180E2000, TRW-RE-000E2030, Thunder until 2000; - OD Cso1-02, - 803-11, -80Ac 12-13, -80Sc14-15, -80Sc6Ac 16, -80Sc6Ac 17-19, 0Sc6Ac 10-21, 0AcBAs 22, 8As 24, 8as 24, Fool Hase Vic. 2-3mior-of ! Knios, "Amice, 1km; of; 2-3mino-n; Haze Vez 3-4minz-zi; * TRWXX reported NANE of AmmAnger; 6-8 of rain reported of WARREN, Joy of Disease Rds, heavy do mage to roads, bridges, humas become of rapid flooding; SE4 DB=T, SW=.01, BP=.05, Illuid Dr. 21.71 12, - @ Ascroi-00, - @ Ascroi , PASCroy-05, - @ Oc. , - @ DCnot, - @ Os - 10, - @ @ Seca 11-12, - @ @ culy, - @ @ Seca 15-18 - OCUBAN OCUSCO-22, - OGACOS, DALAY; FOR/HALE VILL 2mi DC, 1/2mi 07, 2mi 08; 3mi 09; HARE VILL 5m; 01-02, 3mi 03-07, 4-5mi 10-19, 3-4m; 20-24 13 MAKE 85, RW-- @ 1750, L-RODGE ERRO, - CIOI, - @ CIOI, - O CIO, - O CIO, - O CIO, - O CIOS-07, - O OCC) -8 DACIO-12, -8 DCLACIN, -8DCNIS-17, 812-17, BACOO-01, -80AC 22-24. FOR/HARE VISE 3m. or 02, 2 1/2 m103, 2mi 04-05, Imi 06-07, 21/2mig-09, 23/4milo-16; HARRYILO 21/2min, 18-19, 2mi 20-23, 3mi 24 SWA" . OF SEET 14. MAKE 85, TRW+ BIT20 EMED, RW-AITSO EZOIS, (LIENTHING & UNTIL 2000), - & AC 04-02, -& OAC02, -& 04-05 -ODALCO-OT, -BOX-OT, -OOAL.O-TZ, OCLOALOFSE, OALOASIY, OAL IS-18, OCLOAL 19, OCLOAL 21, Da 22, Da Cues, Dans, Fellinge & Imiou-es, Yumios, I'umios, I'umios on io; Mase Vise &-3mici-os, il-iz; 4-6miis EEP* = .04, SWA* : . 17, DB = . 45 15. Ocu 01-00, Oxios, Ocu-or, Occo, -8000-Occis or, Occo-09, -8010, Ocu-Occus, Ocu-Occus, Ocu OCOD CS 16-19, OCO-OCS 20, OCO-OCI 21, -OCI 22, OLZ-24 Goel Fool Home Y12= 3mi 07, 4mi 08; HALE VILE Smi 01-02, 6m. 09

Supplemental Remarks, Ann Aprox, MITCH, July 1978

	The state of the s
16	MAR = 83, MIN=60, O01-05, DC106, DACOT-08, OCAM, DACIO-14, OCAM-16, OCAM-10, OCAM-10, OCAM-10, OCAM-10,
17	MAR = 74, Oo1-05, DEOG, DACOCCO, DACOCCOS, DACOCCOS-11, DC. DALOCC 12-14, DCL WACK
)	OCu -OCi 17-18, OCu 19-22, Ose, O Acay
18	OACO, OOL-13, OC 15-19, O20-24 (FOL AT RIVE)
19.	
20	OACOI, OACOZ, OACOZ, OOV-OC, OAC 07-08, -O CC 09-11, O CU 12-13, OAC 14-16, O CU 17-02, O 23-04 HALL VIITS-6mu 22-23
۵/,	
	6m1 04-10, 15-18, 32-23
22	•
	-60 C 23-24, For / HARE VISE 2m; OF, 2/2m, 07, 3m, 08, 7m, 09-11; HAZE VIJA 4-5m; 12-17, 2m; 18-24.
,23	RW@ 1445, -@ OCI 01-03, -804-06, DACO7, -&DACO8, DACO9, -&DACIO, -& 11-12, -& DACIS, -& DACIA,
	- 80 Cu 15-18, - 817-20, -8 @ Accest-28, -824. FOR / HARRE VE = 2mi 03, Vem. O4, /mi 05.06, 1/2 mi 07, 1/2 mi 08.09
	2 1/2 mi 10; HARE VIS = 2mi 01-02, 3m; 11-21, 21/5-3m, 22-24
24	
	DC100, DC00, DC00, BSCC111-10, DSCC10 BAC14, DSCC115, DSC16-10, DSCORC10-10, DSCORC11, DSCC1
	22, OC. DACEN; HARE VIL - Sm. OC, 21/2miles, 3m. 07, 4mile-09, 5mile
25	. MARE 78, MWE 69; RW-B1100 €1120 B1200 €1500, OCO @ Aco1-01, OCO @ Aco2-05, @ Scok-15, @ Scom@ As 16-17,
	OCO DAS 18, OCO DACOAS M, OCO DACOO, OCO DACOCO 21-02, OCO BACOV. FOR /NARE VISO 24/min, 21/min-10, 3min-15,
	4min ; SEA " 10.29; SWA " 10.15, DB+ 0.15
26.	
	6-11-13; OC++Aco1-02, OS+ PAcaz, €Scov-05, €Sr5c06, -@@&Sr€Aco7, €Sc08-17, @Sc@c. E, OC+-Oc. A-
	-OG 21 -22, O C/ 23-27
47.	- Ear Var & 1/2 = 04, 11/2 mi 05, 1/2 m 06, 1/2 mi 07, 2/3 mi 08-09; HAZE VIL 9-6mi 10-13, 19-20, 44;
	1006-09, OCH 10-10, OCH 13-15, OCH OCH 16-17, OCH 18, OCH OCH 19, OCH OACH - 21, OAC 22-24
98	MANE 80, RW-80645E0715; Food FoolHaze VET 4mi 02-05, 21/2mi 00, 3/4mi 07, 1/2mi 08, 21/2mi 09, 1 Hase VIII
	Smior,10; @Acoi-05, @Acou, -80 Scot-08, -8004.09, @Se 10, @\$11, O C. @ ScOAcia, O C. D. Scoa, O C. D. & Caro,
	@ScCu 15-17, (DCL 18-20, (DCL 31-24) DB: .03, SWA': 0.06, SEA': 0.09
29.	\$ \$ 601, \$ \$ 602-04, \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$
30	MAXE 79, RW- 81430 € 1530, Thundra @ 1400; OOI-OE, OCCOO, OA OCCOO, OCCOO, OACOO, OACOO, OACOO, OACOO,
	DAK GAL B-14, - & O C. O C. O A. IL-10, O C. O A. M. BHOD, O S. O BROD, O S. O HOZ, O C. O AROJ BALJU. FOLL
	Nore Var 4-5min- 31, 2-3mi 20-3, Here Var 5mill, = 1/mily SE 11 = .08 SW A2 = .08
31,	TRW BONDE 0245, (SEA+ TEW BO220 & 0215); TRW EH45E1230, RW-B1300E1345, FORM FRIME VITE 3m. 06, 1 1/2 m. 07,
	Im, 08, 16m; 09, 2m; 10,3m; 11; HAZEVIS= 2-3m, 01-05, 5-6m; 13-14; AR D, DScox, OSCOZ, OSCOZ, DScoz, DScoz, DScoz,
	Co, DOSARCO, -DODACOS, -ODSCOACOS-11, -OOSCIA, OSCIA, OOGACII, OFFICE, OUCACOAC, OOGACCIA
.Es:	40 G.C. 20-24. SEA-10.47 PTWIND + SAMAN /SW / 0220 EDT SWA-2.32 08: 15
	SE + 3130 Fernwood, Sw - 1818 Orchent, DB = 2816 Beackman, DPE 4041 Thomanks

	Supplemental Remarks, Figure 1979, Amerikan pet
`\	ALL TIMES ARE EDT
,	MAX = 75, RW-RUSISENDO, RW-BIB4SE 1500 COM RW-BISDE 1645, R-B1645, Feb. 18- 4, 2 //on 20-21, 3mm, 2 m 20-21
	Food these Vine Smith, Smith; Oa Odice, Buck of , Buck of, Oa Ok as so, Dr. J. Cop, Oa Steward, Oa Stee, Os Ches, Can- & De
	. Che 20-21, ⊕ Se Sr 20-24
2.	R-E-0130, TR-BC130 E0100, K-B0200 E0330, L-B0320 E0430; FOR VISE 1 Nome of, 1/2miles, 2miles, Fort Harl VII-2miles, @Sit Toroto, Jan.
	.08, @Scot-10, @Colo. Octoby Zerepoll-2: SEE 35, EE= 55, SW= 65, DB= 42
3	Rev- 81530 €1600 , Food Horse 415 - Son Co, 3mm 57-08, 4m 25-23; Horse Vas Son 17-18, Coming 3m 21,24; Obrece, +08 57-10, Olary, Edd 16 4,
· · · · · · · · · · · · · · · · · · ·	Da DA OC 18-14, Da DA CIF, OS BACIO-17, Ja BACIO, 666 15-20, Da 21-22, OSTILL FEE : SE : 18, SWE.OI, ELE : CI
· 4	FOUNDE long, Neminosoc, Namioson, 3/mila; Foct Aree No. 2 kmios, 2milaros, 3mili, TRUB 12.08/95, Privada 33-prila - 117455
	_Oot-03, _004-04, @ot-03, -@Ola 10, On, Olars, Dais, Dais Actoris, Ola Ola, Cal Con, Ola Elis, Ok 16, OA OK: 20, Elic &
	- 12-12, WA-23-34, PCP . SE= 30, SW= 24, OCE = 28
<u>-</u> <u></u>	Rumo 1215, TK4-8 1315 E 1430 , PKWINO = 33mph/SW/ 1458EOT, FORM HAZE VIST SMIDD, 311 STICE; FREE VIST MINISTER, @FRANCE, OAZ
	to. Clare, Ook, Our som, Oar Oker, Decakersty, Oar Oker, Oar Oker, Oar Oker, Oar Oker, tock in tock in the
است. مد د	_ FEON SELECTION, INTROPUSCERION
	MIANE 79 , OSCUMEZ & CS, OSCUMES, OGENER, OGENER
· · · · · · · · · · · · · · · · · · ·	More than 5 minor 18; Philima & Symph / Will 1523 Ett , Doings, Old - te Ring Out - te Ring & Care, & Ring, Care, & Ring, & Care, & Ring, & Care, & Ca
	Tair, OG Dair, OCo, Dan, Danser, DALLY
\ 8	MAX= 85, RW-101200, Con. Ofices-os, OACOU, O Corros, OACO, OACOU, & CAU, OACO, OACORIO, OCC DALLE
	M-15, DOWORE-TOOK, OS. OR. O. O. C. REIS, DOW CAR 15, OO OR RESE, OB CROSS, US CARSE, Walkers, DAVER
<u> </u>	MINKE 76, RW-BOYUSE OSUS BOGUSE 1000, MORE VIES SIN ALAS, MINAZ, 3m 24, ORES. OF CO., OROZ-CU, CLOBECOS-OG, CACOR COS
<u> </u>	. Oa Dr. BAS. 10, BAS. BAS. 11-12, Da BAS. 13, Da BAS. 15, Oa BAS. 10 , Oa BAS. 17-15, Ofice DAS. 21, O 20 22-22, Called - 195 a.
) 	SEF, 08, 3W = 10, BEF 10, BEF 109
/0	MM = 61 , TRUB GEODEUSYS, RW-BOSYSE 0630, PRWWD= 48mph/W/ 0500ECT, FORINE 4m 11 HAZE VILLE 3m C1, 24m C1- C5,
)	. ORON, ORGON, OCTOSON, OSCOS-OC, OROBEOGO, OROBEOGO, ORODE OROS, OROBEOGO, OROBEROS,
) 	Da Dileane, Da Oferens, Da Oferens, Ofer DACES, Sery Per 18, 500, 008:00, 008:00, 008:00
)1	MARE 71, May = 51; BSc 01-04, DSc 05, DACOS, DCW DAO 07-15, DCW DACOS, DCW CRED, CAMBER OF DAGE OF DAGE OF COMMERCES, COM
)	1-Os(24)
) . 12	
) /3_	MARE 72, RW- BOOISE 0630 BIGISE 1845 B2330; RW- 1430; MAZEVILE SMI 20-22, 4m 21 SMI 24; -00001, -0002, 50=2,00
)	OY-05, DA. OCEDE, OBEGGOZ, OSEARESS-10, OAR BASIL-12, OCEDAS 13-15, OKNE-12, OSEDARA, OCEDARA, OCEDARA,
) 	⊕3c24 Sw=,07, 3€:,09
) 14	MINISO, RULE COIS, PRUMO = 34mph /OW / 1745EDT, @SCOLOD, @SCOS-OY, ISCCOS, PARAS, CARCOS, DA-Dan Farma
) 	(Ca 10, Dani-12, Oake 12, Oake 14-15, Oake 16-18, Oake 16, Cadalia, Oas-24)
) . 15	Oo , O @ 02-04 , Escos-08, O a O Q os , O a 10-17, O a O Q w-19, O a 20, C (121, 025-24)
) "	. O +1-64, Oa 15, Oa Cell-12, Oa 13-15, Oa Oc 16-18, Oa -Oc 19-20, Obe 21-23, € Aczy semine 406, receives an
) / 17	MAXE 60, RW-BODYSE 0230, RW-VAW-BOOCUE 0945, BARROMSUE 8830, LARASTET, FOL VILL SHIPS, - 36 H. LANG PARCE, PARCE
) 	Emily, - los, 1/mily, loves, 2migres, & horsely & Claus, Os Acoz-vajo Acor-co, Os Electron-11, Os re-10, - Obschaus -
(≤ PAP 17-19 MUL ZE: 1.56, EE: 1.41, SW= (35.
. 18	MINICE, LIEUNZO, TRIBELIZOE 0245, R-E0245, EU415 E0500 E 0830, K-VR BONISE 0500, Thunder 3070, FOLVIST 216m ours, And is
, , , , , , , , , , , , , , , , , , ,	Parmier, Imios, Barcos, 2mios, 18mios-os, 2mios, 24mios, 4mios, Harevisa 3-yai 18-24 18 Nobe circos, -4005c oc-11 (15c12-23) Cachy 71

ANN HREOR, MICHIERN, AUGUST 1977,

19. RW- BITHSEISIS, Fost HARE VIS - 3m. 01, 15m. 02, 24m103.04, 6; Hrze VIS - Sm. 05.07, 3m. 05.07, 3m. 05.00, 4m111-33, 5mj. 1, Oc., . - ® as, @ Sec= as, @ ca=6, - @.-@ ch cr, -® Ociec, az, - ® Ocion, -® Oci. 10, @ Se 11, O Se 12-13, @ Si € 14, 14, O Si @ fe 14-, @ Si € 1/c 14-18 Dicarely, @AcDC: 20-23, @Ac24 20 MAX = 69, IIIN = 59; KW-8"0345E-035, RW-381045E1530, RVR+81530ENIS, R-BIJISE1745; HAZE VII. Smiotoz, 6mioto. 4milly Gorla-14, 4mils, 23/4mills, Smilt; PACOI, DACO: DACOCO3 DACOY, DACOY, OSCOACOT, OSCOACOZ-O9, OSCOCOS-O9, OSCOCOS-O9 DEODIC 15, -8 DSC10, DEC DACIB, DEC DACIT-20, DACD CT21, 1 AC 22-24 POPE SE = .33, EE = .53, SW=.52 21. WAC 01-02 , O A co3-06, DACCC 07-09, -OC, 10-12, OC(18, OC(18-17, OC) 18, OC(18-21, O2), OC 22-24 Fools - Young 22 MAX = 75, RW-0 1600 = 1800, FOOd FOOd HARP VILA 3m.07, 2m.08-09, 21/2mi 10, 11/2mi 10-14, 21/2mi 15, 2mi 16, 11/2mi 17, 1mi 10-21, 1/2mi 22 2m. 12-24; HARE VIS - 5m. 05, 3m. 06; O01-06, O (107-08, - ODS, - OCOF, - OOG OCOF, O Sell, - OSEL2-14, - OFFICES-17, 18 @ 37 @ 10 - 10 BS - 22 - 23 - 18 B & 24 PCP : SE = .03, E6 : .04, SW = .04 23 TRW-BI415E1420, TRW+1430E1445, TRW-BI445E1545, RW-BI618E1715, PW=34mph/5/1430EDT, Fockis = 1'2m 01-02, 4m 03 : 25 m. 2 m. 06, 18 m. 10, 14 m. 10, 14 m. 11, 1 m. 12, 2 m. 13, 2 m. 14, 2 m. 15; HASE VIS = 5 m. 16, 6 m. 17, 4 m. 18-20, 3 m. 22, 5 m. 23; -BASc 01-03, BSc04-05, ASTOC, BASTO7, BOS-11, BAST12, BOSC13-15, BallAck, BallAct-19, BScAccan Ow OALD, Oilery PCP: SE = .27, EE = .45, SW = .45 24 Min=57, RW-BO40080430, FOL VIS 3mio3, 2mio4, 11/2mi +5-07, 2mio8-11, 21/2mi 2; @ALOI, OCL @ALOZ, OST @ALOZ, OST @ALOZ .05, -805,706-07, WOSTBX 08-12, WSCC6 13-16, OGDG17-19, -OC120, OC121-22, O22-24 1456= EE = .01 25 FOOTHARE VISE 4m, 07-08; OOI-06, OACOR, OACOR, OACOR, OAC-OCIDON, OCOOCSIR-13, OCOOCSIR-14, OCOOCS 17-21, OC 22-24 26 Sene RWT BISYSEINS, PWTB 1745E1845, FOR4 HAZE VILL & m. 07, 3 m 08-10; HAZE VILL GMIN; DC101-02, BC103-06, DA: OCO, OAC OCIO-10, OACII, OCO DAACOGIE, OCO BACACOCIE, OCOBAIN-17, OCOBALIE, BALIS-24 271 - PW--174551800, Fort Ford Hotely = 3m. 05, 2m. 06, 2 " m. 03-10, 4m. 11, 3m. 12; 41.25 1/15 - 4m. 09 3m. 13, 5m. 10-19, 4m 20-20, Brown, Sincery Ow & Food , Osc @ Actions, Oscos, Owor, Oscos-06, Oscor, OscOAcos, Oscorno, Osc Ofici, Oscor, DScoring OScholog DSch Dleso, -ODScOkesi-22, -ODGOAcss, @Acst 25 RW-- B1730 21715, RW-CZIISE 2200, For & Forthose Vise 2mion, 12mios, 12mios Imila, Jamin, 3milz, 4milz, 6milla, 4milla, 5mille, - Haze Vise 3-5milla-20; @Acos, - @ DAcos, - @ Str. 03-04, @OS-10, -DOSTELL 11, OCOO HOO. 2, OCOBELL, OCOBALIN, OLEIS, OSEBALIL, OCOBALIND, OCOBALIND, OCOBALIND, -BODA BALAS, -BOOG DAR 24 29 . RW-- BIO45EJILEBI270EI245, TRW-BIJISEI145, (RW+ OVER SEA* BI930E2000), TORMADO (8 MILAN \$ 1630, FOR VILL Sm. 01, 1 3m. 02 -06, 11/2me 07, 3m. 03, 2 1/2m. 09, 2m. 10-10, 3 1/2mi 13-14, 5mi 15; € Cu 01, @02-03, € Sto4-06, ® St⊕ Se07, ® St⊕14 . 28 , Ø St Scoq , @ St 10, -@ Ø St 11, -® Ø St B& 12-14, @ Sc 15 - 16, @& DA 617-19, @ Sc € A 620, Ø Aco, O Aco, O Cc 22, O 23, -O Cc 24. PCP = 36: 21, 66: .04, 5W1.06, 5681,02 30. Four HARE VIL = 4m. 05, 3m. 06, 2 1/2 m. 07, 1/2 m. 08; HARE VIL = Smior, 09-10; Ooi-06, -Doz-08, Ooz-12, Ocu 13-19, Badison, Dans, Dan Dassy 31. HAZE VIL > SANOT-09, -OCION, DOJ-00, OHEOT-08, OO9-13, OCI 14-18, O19-24 MAX = 81

Presip. Gause Formier. 17 SEF 3130 FERMANION

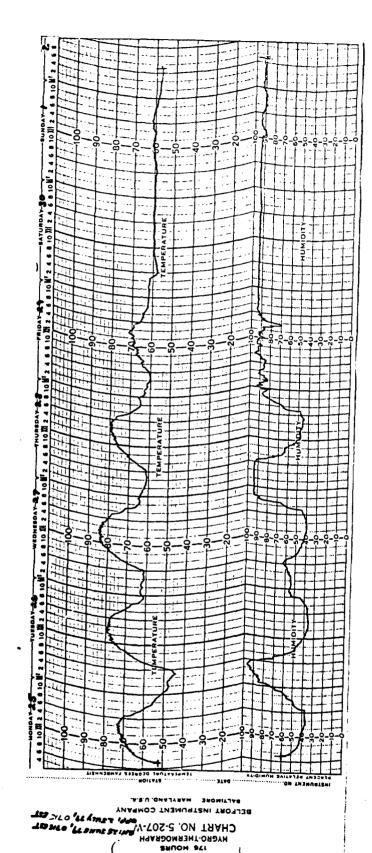
Sw. 1513 Dicken

CG/3: 23/G Brackman

10°	
4 3	ANN ARBOK, MIT, SUPPLEMENTAL REMARKS, SEAT. 1979
A. 9	ALL TIMES ARE EOT SEE NOTE ON BACK FOR AWERROR WY 165 S. Imph , AW: Comph
Vir	1. FOG VII . Smide, 12mios, 1/mios-09, 3milo, 4mili-12, Smilo-16, HAZEVIE 4milo-23, 3mily, ; Ooi-06, -80 Hear, 103
4	-30 He 09-10, -8 O Ca @ Ac 11-12, @ Ca @ Ac 13, O Ca - O C1 14, O Ca O C15, O Ca O C5 16, O Ca O C5 18, O Ca 19.21, O 5.3.
ŀ	2. FOE/HAZE VIS = 2mio7, 1/2mi03-09, 1/4mi10, 1/2mi11, 2mi12, 2 /2mi13; HAZE VIS 3mi01-02, 4mi03-06, 4mi15; 00-02,
A.	-O CIOY-OG, -OAROJ-11, -OEZIZ-13, DSEBACIY, OSEDALIS-17, OSEDCIR, OCU-OCIT, OALOGIO, OHLIN, OILLIS,
4	D C. 24 WY= 224 % (3mph, Au= 6.9mph)
1	3 TRW+ BISYS EISSS (TRWX Soura AMARGOR BISYSFESO), FOOVIL = Nymior, 1 notor or, 3mino, Hazelfor VII 4mios, 2mios; (DC201,00
€ :_	: Co, - O Ceo? , B Acoz, D Sell Acor, O Seo, O Co DACII-n. O Cu D Acis, O Co O Cis, O Co O Acis (Orec N), O Cb (DACK S) 17,
(Don Acir, Ocio, OAcaq-21, Oasi, BAca, & Scar. SEA's 37, SWA's 21, OCE = 13, EE' OC WV= 88° 10 amph, AW . 4.7 mph
3 C	4. RW-@0100, FOLVIS 3 mor, 6ming 1/2mins, 2ming, HARRYILD STILL, 6mill-1, 5mino, 4min; MollARREVE 2min), Oscol, Ocios,
₁€ .	⊕ Sca3 - 13, O Qu.14-15, O Qu 15-17, O Qu 18-17, O Acop, O Do 1-24 NV = 85°/36-pb, AW= 49-mph
€	5. Foe Vis = 3mios, 2mi 02-05, 14mios, 16mios, 10mios-10, 1min, 3mile, 2mi 23, 2 mi 24; HAZEVIS = 3mile-14, 4mile, 5mile, 4mile, 3mi
4€ ,	For /Hoze VII = 2 1/2 mi = 0, Oor -05, -@OC. O. 06, -@OS. 07. OOR -10, OS. 11, -& 12, -@OC. 13, -@OC. 17, OC. 15-16, OC. 17-18, -@OC. 19, -@OC.
€>	30-21, - @ O.Ce 22, - @ 28, Q24. WY= 100°/29 mph, AW= 4.3 mph
G	G. Mar= 81, Mav= 57; Foo VK = 2" am 01-03, 1 am 04, 2 m 05, 2 2 m 06-08; HARE VA = 3 m 10, 5 mi 11-12, Oci 12,
(%	OG +OC113, OC 19-20, OA. 31, O22-24 WV = 292 16 0 mph, AW=6.3 mph
€.	7 Max: 67, Mino 50, Col-oy, DGOS-ON, DSC10-II, DSCDACIZ-20, DSCCUZI, DCUZZ, DACZZ, OACZY WV= 3230/6 Smph, AUT 7.2 mph
.C.	8. Mar = 60, Osi OAca, OCuos, Osy -08, OCuos, O Cuo, O Acii, O Sciz, OSciz, O Scientiz, OScia-22, Oss-24 Acis Simply
4	9. Co1-06, OACUS, OOR-10, DACHTIZ, OCHOALIZ, OCHURTS, OCHOACIC, DACHT-18, OCHOACIS-18, OCHOACIS-
₹ \$	10. HAZE VII . Sm. C7, Ooi-UZ, @Aco4-02, @Aco4-11, -@ G12-13, O14, -D G15, OCDG16-17, @ScAc12, @ScA
(Z	11. Mine=72, \$5001-00, CACIO, @CUIT-14, DCWBACIS, @CUIL, @CUIT-18, O10-24 WV= 9944.2 mph, AW= 63mpn
(12 Mizo Vis 4mi on-no, 3mi 11-13, 4mily - 18, 5mily, 6mily, 3milo-11, 24milo, 2milos-24, O 01-04, O Ce 05-00, Cos-13, O 01-4-15, Ca Oi
—	K, Dad Acis, DACID-20, -ODACID-24 WUE 146º/49mph, AWS.Imph SEA' MIN & SO
4′	13 Min- 38, ROM 191645, R-B1945, FORVILE Nam. 07, Im. 08-10, 1 / mill, 2 / mill, 3milla, 2milland, Forling Vise 2million, 3milland
is	HARRING 3m. 15.16, 5m 17-18, 4m 19-21; BOACOI, OACOZ, OACOZ-O4, OEC 05-OC, OO, -BSTOR, -& DSTOROZOB-14, -& OCE 13-15,
•(}	@ F. OCIO, DA. OCIO, DE OCC18-19, OS. DACOGO, QS. DACO, OSCODA LO WV = 196-140-ph; AW= 6 3-ph, SEA MINTEST
1(Ç.	14. MARE 67, May 49, R-E0230, R-30230E0200, Follie inioi, Hazeline 2mos, 2 hmios; & Scoper, DScotor, DScotor, DScotor, Dallitic
16	
<u>N</u> ,	is Ofici, Jos- 06, Oca 07, Oca 08, Oca 09, Oca 11-15, Oca 18, OR-24 WY 282 / S. Imph, AW = 5.4 mph
(16 001-13, Danie 18, 019-24 W= 2530/49mph , AW= 5,4mph , SEA2min=42
4,	17 For Vise 7mi στ; Οεντος, -Φείντ, Οοβάλη ων = 221 / 6.0 mph, Aω= 6.3 mph , SE 12 min 245
	B MN=50, FOW VIE 7mi OC, Imi 07-02, 2mi 07; HAZE VIE 3mi 10, 5mi 11; OOI-OL, -800-04, O10-12, OHE13, O14-5, Dai 16-20,
ŧ	Dar-24 WV= DC1° / 5.8 mph, AW=7.8 mph
í	17 MART G3, OO1-04, DC407-13, C14-24 WYT missing, AWT missing
ļ	20 For VII. 7 7m107, O01-13, -0 C117, -0 C117, -0 C117, -0 C3 20-20, + CSay W= 210-/6.3 mph, AW-6.5 mph, Sent more any
	* MINE SO MINE 30 , FORTHER VILL 3mi 08 , MARS VILL SAMIOS-NO OMINITY CONTOR, WHOSTOR, WHOSTOR, WAS MINITED AND MI
• •	12-13, @ Ou@Ac14-15, @ Cu@ Cs16, @ Cu @ Ac 17, @ Cu@ Ac 18-19, @ Ac 10-22, @ Ac 22, O ay WV= 339 1/22-10, AW-5.2 +114
,	22 MAX+64, MINE 41, Danois, OAcos-or, OArDreas-or, Occos-or, OAco, O and Acos-or, Occor-or, Occos, Occos, Occos
•,	(C) C) (C) (E-22), O23-24 UV = 17 / 69mb, AW=7.3 mph pKWm0 = 32mph/NE/1207EOT, SH N = MIM TT 773

B SCATTERED FROST AM, DOIT,	17, Wrote, Other, Oat	SEPTIMATES LINKS	58 /5.1mph , AWE 6) () () () () () () () () () (
24 FOO VIS = 6 m. 07, OUT-04,				
1 1k 24 WV= 147 \$ 2 Omph				
25 MN = 47, KW- 3 40230, (PC14-15, @ Cu 16, (Da 17-18, OAc19
- WY= 266.1.				
26 Oo1-24 WV= 269./38				mm=42
27 HAZE VI: = 5m. 21-24, Ooi-			SE A.	m in = 42. 1º/4.5mph, AW= 5.4mph
28 Max-69, FOLVII = 21/4 mios				
Howary Hope Vis & You Hole,				
⊕Scm-12, 10 Curs, 1020-23				er en
29 For Vise Mamier, 3 miles - 0:				12,5mi 13-19,
Gm. 20-21, 4m. 22-23, 5m.24				
WV= 205 /38 mph, AW= 4.7 mph		The same section of the same o		
30 FOR VIA & BING OFFER, 2 Vermi as		17, Im, 08, 3/w. 01, 17/4m1 ,00	Fos Hazeliza 2 Km, 2	My HAZEVISE
1000 m 14, 1000 cm - 10 Pec 15.	,-80Aci,-800)	-® 01-07, -® +D 1008, -&009-10 17-18, @@19, @Ac20, @@11-24	wu= 292°/36mp	in, AW= 4.9 mgh, minist
				y
WYT MEAN OAILY WIND VECTOR		ere 🕶 - ere ere		\
שני שמים טרוני מאוט יודבים				
•	,			
PEP GALE LOCATIONS SEE	3/30 FEFFULLOOD	**		
Ş.w -	1513 Dickers		· -	
<i>ରିଓ</i> : ,	EAST ENGINEERING BLDG	•		
DCC =	- 2316 Brockman	•		
	Section 1 to the section of the sect	والشباه والمحافظ المارا المحادات	+ · · · · · · · · · · · · · · · · ·	
BECAUSE OF A BAN CALIA	ERATION, THE AVER	THE WIND SPREAS & VECTORS	PRF INSPRIGE	
TO CORVERT 145 TRADE,	USE THE POLLOW	104 FORMULA:		
S) and S	prod (TRUS). T. WIND	Spend (040) #1.32 + 0.11	(in milas/hour)	
				•
	* * *			
and the second second			-	
	-			
	•			- ,

.



2 July 1979, 0715 EST. 25 June 1979, 0715 EST; Off: Hygro-Thermograph Chart 0 1: (a)

Figure B-2.

75

'V'S / AF #35LRIES

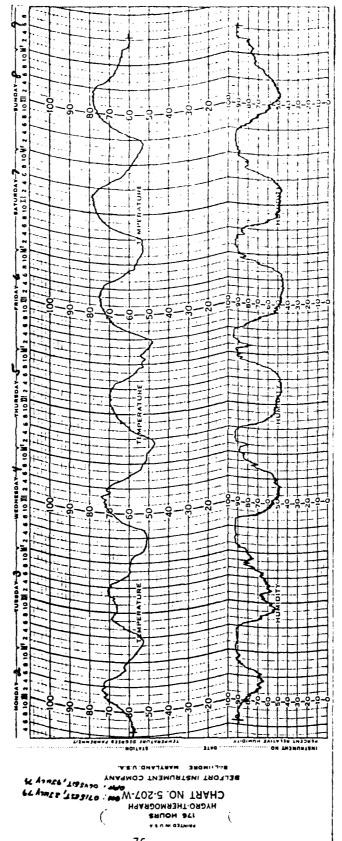


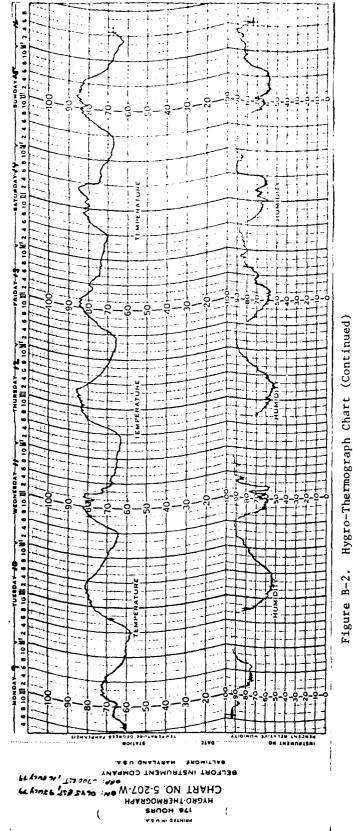
Figure B-2. Hygro-Thermograph Chart (Continued)

2 July 1979, 0715 EST; Off:

0n:

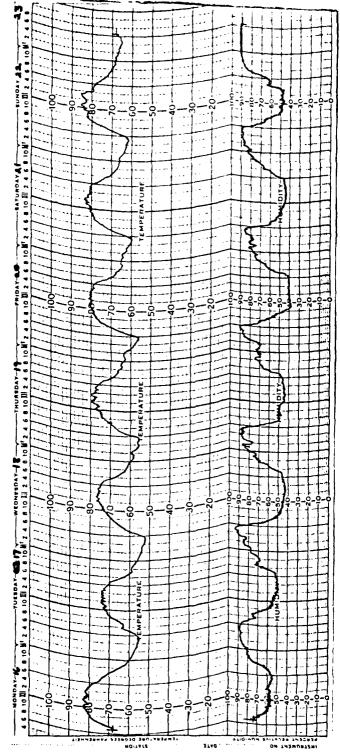
(b)

9 July 1979, 0645 EST.



16 July 1979, 0700 EST. 9 July 1979, 0645 EST; Off: 0**u:** (c)

77



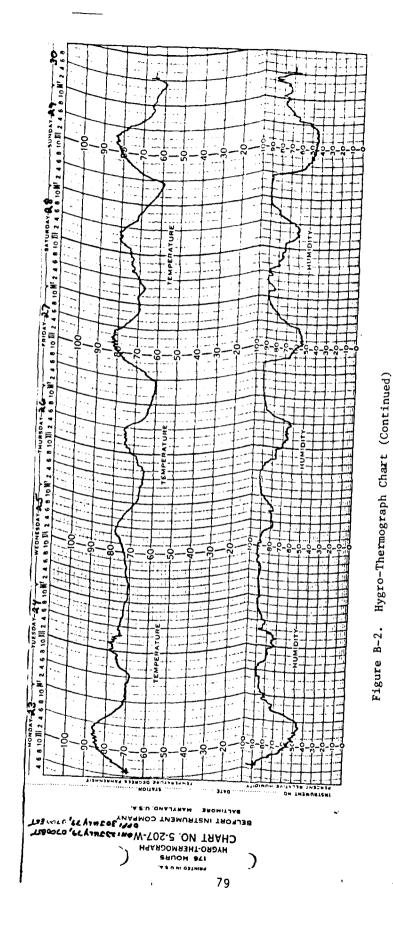
Hygro-Thermograph Chart (Continued) B-2.

July 1979, 0700 EST. 23 16 July 1979, 0700 EST; Off: 0**u**: (P)

A & U GMAJTRAM SPOHITJAB

HYGRO-THERMOGRAPH SHUOH STI

BELFORT INSTRUMENT COMPANY CHART NO. 5-207-Wow, M. Pary 79, ProcesT



30 July 1979, 0700 EST.

23 July 1979, 0700 EST; Off:

0n:

(e)

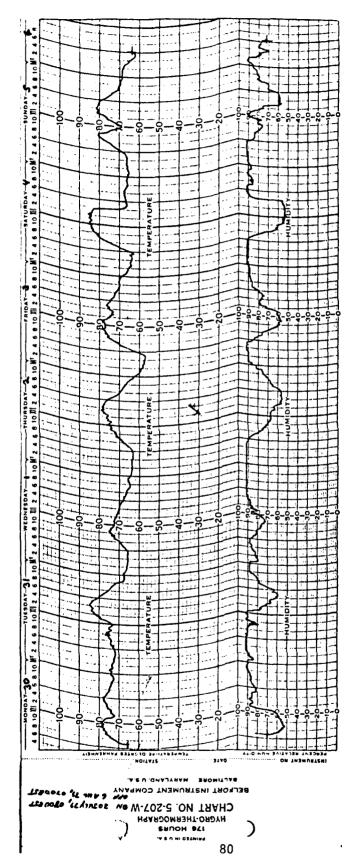


Figure B-2. Hygro-Thermograph Chart (Concluded)

(f) On: 30 July 1979, 0700 EST; Off: 6 August 1979, 0700 EST.

REFERENCES

- 1. A. Lawson, "Climatology of Selected Areas of West Germany Affecting Sensor Performance", ERIM Report 138300-23-T, June 1979.
- 2. A. Lawson, "Terrain Characteristics of Selected Areas of West Germany Affecting Sensor Performance", ERIM Report 138300-39-T, 1979.

PARTIES CALLED

DISTRIBUTION LIST

U.S. Army Mobility Equipment Research and Development Command, Mine Detection Division Dr. J.R. Gonano (DRDME-ND), Fort Belvoir, Virginia 22060

8 copies

END

DATE FILMED 8-80

DTIC